



Me ora te Ngāhere: visioning forest health through an Indigenous biocultural lens

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Handling Editor:

Mike Calver

Received: 20 July 2022

Accepted: 12 May 2023

Published: 3 July 2023

Cite this:

Reihana KR et al. (2024)
Pacific Conservation Biology **30**, PC22028.
doi: [10.1071/PC22028](https://doi.org/10.1071/PC22028)

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ABSTRACT

Explanatory note. *The following text is described in the Ngāti Rangī mita (dialect), although concepts may be similar e.g. Mouri = Mauri, the spelling reflects the tribal vernacular.* **Context.** National biodiversity monitoring in Aotearoa, New Zealand is primarily conducted within Eurocentric conservation frameworks. At present, Māori (Indigenous Peoples of Aotearoa) have limited interaction and role within these programs. **Aims.** We explored a biocultural monitoring tool based on *mātauranga* (Māori knowledge) to inform Ngāti Rangī (a central North Island Māori tribe) about the health of spatially separate, but ecologically similar, forests within the Ngāti Rangī tribal estate. **Methods.** We did a series of *noho taiao* (community workshops) and one on one interviews to collect the values that expressed a Ngāti Rangī world view, to measure the health of the *ngāhere* (forest). Gradients and indicators were developed to apply a measure of *ngāhere* health. The metrics were trialled in three forests to create a group understanding. The interviews provided an observation of *ngāhere* health and assessed intergenerational differences in how forest health is perceived. **Key results.** *Rongoā, Manu, Ngāhere, Wai, and Tangata* were themes prioritised by Ngāti Rangī. Biocultural indicators revealed moderate health across the three forest sites, whilst the more ecological-based indicators indicated moderate to strong levels of health. Age-related differences in how forest condition indicated evidence of an inter-generational shift. However, it was agreed that the forest health had declined over the past 30–40 years. **Conclusions.** A full sensory evaluation of forest health facilitates a deep relational connection to place, which coupled with philosophies such as reciprocity and *whakapapa*, are vital features of a biocultural conservation approach. **Implications.** Cultural–ecological constructs are key in relationships between Indigenous Peoples and their environments. Biocultural approaches can contribute to reversing the current biodiversity crisis, through partnering in placed-based solutions.

Keywords: biocultural, biodiversity, biodiversity conservation, biology, conservation, conservation biology, conservation tools, culture, ecological restoration, ecology, forest, health, invasive species, New Zealand.

Introduction

Ngā kupu tohutohu i waihotia iho,

Hei whakahoehoei i te motu nei e.

For these are the teachings that have been passed on

For me to practice and apply throughout the land. (Kuia, Moe Ruka arā ko Anaera Mareikura, The waiata Whakapuकेपुके Ai, 1948; Che Wilson, 2021)

Explanatory note: *The following text is described in the Ngāti Rangī mita (dialect), although concepts may be similar e.g.: Mouri = Mauri; the spelling reflects the tribal vernacular.*

Indigenous Peoples and Local Communities' (IPLC) tenure over landscapes globally comprises 22% of the Earth's land surface area, and is understood to hold an abundance of the planet's biodiversity (Sobrevila 2008; Ogar et al. 2020). Subsequently, the leadership of IPLC and inclusion of Indigenous and Local Knowledge (ILK) are becoming increasingly recognised as key elements of programs to monitor, conserve and restore biodiversity, in assessment initiatives from local to global scale (Ntiamoa-Baidu 2008; Gavin et al. 2015; Sheil et al. 2015; Muashekele 2018; Paul-Burke et al. 2018; IPBES 2019). ILK systems can provide valuable information relating to the health and condition of environments, but also the wellbeing of communities reliant upon those environments (Lyver et al. 2017, 2019; Aitken et al. 2021). However, despite the recognised importance of ILK, challenges remain around IPLC justice and self-determination (Nadasdy 2009; Jones 2013); empowerment of local institutions (Almudi and Berkes 2010; Hoole and Berkes 2010); intellectual ownership of knowledge (e.g. Free Prior and Informed Consent; (FAO 2016)); knowledge interpretation and decision making (Ellis 2005; Stevenson 2006); and the integration of culturally diverse knowledge systems (Tengö et al. 2014). Current conservation goals and future strategies to achieve sustainability globally are not being met from current conservation trajectories (Diaz et al. 2019). To achieve targets such as those within the Convention on Biological Diversity's (2018) Aichi Target 18 by 2050, IPLC centric strategies, processes and ways of being are vital additions in protecting biodiversity (Forest Peoples Programme 2020). Further, IPLC worldviews that address the disconnect and disharmony between nature and human societies are predicted to play a key role (Forest Peoples Programme 2020).

Māori (Indigenous Peoples of Aotearoa, New Zealand) are strongly committed to reasserting *rangatiratanga* (self-determination), in the management of their natural resources. Notably, Māori maintain relationships with their ancestral lands, freshwaters and seas through *whakapapa* (genealogical hierarchy) (Marsden and Royal 2003; Lyver et al. 2017; Aitken et al. 2021, Belcher et al. 2021). These connections are framed by one's ancestral lineages woven through the physical and non-physical world, comprising of the responsibilities, obligations and reciprocating relationships that have been passed down through the generations (Nepe 1991; Timoti et al. 2017; Bishop 2019). As part of reasserting *rangatiratanga* rights, Māori cultural and ecological health frameworks are increasingly being used to monitor environmental change in Aotearoa and inform policy and decision making (Harmsworth 2002; Tipa and Teirney 2006; Awatere et al. 2017; Lyver et al. 2019). A significant aspect of *rangatiratanga* for Ngāti Rangi is the right to manage and measure the health of the environment based on this premise. However, to manage the environment based on *mātauranga* (Māori knowledge) requires an understanding of its health and wellness. The environmental

wellness is intrinsically connected to *mouri* (life principle or vital essence of being), *mana* (authority and prestige) and *oranga* (wellbeing) of the Ngāti Rangi people.

The use of *mātauranga* as the baseline for understanding the forest from a Te Ao Māori (Māori worldview and values) allows cultural constructs such as *taonga tuku iho* (treasures passed down through generations, intergenerational knowledge sharing) and *kaitiakitanga* (see list below for definition) to emerge, contemporary references to cultural constructs are presented in Aitken et al. (2021) and Belcher et al. (2021). Definitions of these core cultural constructs from a Ngāti Rangi point of view are as follows (Harmsworth 2002; Tipa and Teirney 2006; Awatere et al. 2017; Lyver et al. 2019):

- (1) *Karakia* – the reciting of incantations which acknowledge the environment and its reciprocating benefits that exist between humans and, the animate and inanimate beings of this world. It evokes a sense of enlightenment for our transition into another world, a spiritual, mental and physical transition or state of mind.
- (2) *Rangatiratanga* – applying the right of self-determination, being able to create from traditional ways of knowing and being, in order to govern themselves with their own understanding of the world.
- (3) *Whakapapa* – the connection to environment (*Papatuanuku*, earth) through kinship relationships. This connection is recited in the order of its origins. The lineal connections from the gods (eldest beings) to the humans (youngest) and all living things on this Earth. This concept holds the Ngāti Rangi lineage connections to these forests, rivers and lands.
- (4) *Turangawaewae* – understood in Ngāti Rangi as 'a place of belonging'. It is the most empowering expression of ones right of and 'connection to a place'. It is usually associated with one's *whakapapa* family lineage and or family's connection to a place through an event.
- (5) *Kaitiakitanga* – a holistic epistemological view of a cultural and natural world relationship where Māori act in an obligational role of stewardship or guardianship within the environment. One of the key elements in enacting this caretaking role is the protection of the *mouri* within it.
- (6) *Mātauranga* – most widely known as Māori knowledge, here its use is in terms of the traditional practices of the Ngāti Rangi people, which guides their understanding and decision making to enacting *rangatiratanga* and *kaitiakitanga*.
- (7) *Taonga tuku iho* – treasures passed down to us from our ancestors, tried and true wisdoms from old and intergenerational traditional knowledge sharing.

Here we report on the Ngāti Rangi example of parameterised metrics of forest health embedded in their worldview and how this expression supports Ngāti Rangi assertion of *rangatiratanga* in their co-management aspirations.

Embedded in these core system principles is the enduring Ngāti Rangi ways of knowing, living and being such as cultural harvesting practices (e.g. only taking what is needed; *utu* or reciprocity, giving back to the environment more than you take; this was also seen in the comments about the understanding of *manaakitanga*). Other strong principles include the heritage legacy from their *kaumātua* (e.g. the values instilled by their grandparents, trees that are named after their ancestors to mark events and places). The heritage legacy embodies all their *taonga tuku iho* – intergenerational knowledge which is passed down.

Decades of legislative transformation have signalled and championed this change in New Zealand with the implementation by legislation and policy such as the [Resource Management Act \(1991\)](#) (NZ). However, environmental systems that better empower *Iwi* (tribes), *hapū* (sub-tribes), and *whānau* (families) in Aotearoa are needed (e.g. *kaitiakitanga* – Māori customary conservatorship; [Roberts et al. 1995](#); [Aitken et al. 2021](#); [Belcher et al. 2021](#)).

The goal of this study was to develop a *Te Ao Māori* (Māori worldview and values) biocultural approach, based upon the way of knowing and being of a central North Island Māori tribe, Ngāti Rangi, that linked understandings of forest health to the community. Although there was an interest from Ngāti Rangi to conserve keystone cultural species, such as *kiwi* - flightless native nocturnal bird, *Apteryx owenii*, *kereru* - NZ Wood Pigeon, *Hemiphaga novaeseelandiae*, *titi* - Sooty Shearwater or mutton bird, *Puffinus huttoni* etc., the community desired an approach that considered the broader forest environmental health and how community members interact with their local environment.

The Ngāti Rangi tribe had a registered population of 1450 in the 2018 New Zealand census ([TKRC Trust 2019](#)), in the Ruapehu region where the tribal area is located. The natural tribal forest estate of Ngāti Rangi is considered to be a pristine environment ([Ruapehu District Council 2018](#); [Brooker 2019](#)).

Our objectives were to construct a Ngāti Rangi biocultural vision with key cultural values and themes identified by *kaumātua* (esteemed elders) and *ngā tāngata tiaki* (environmental guardians guided by their *kaitiaki* (traditionally a guardian or spiritual messenger from the natural environment eg, birds, mammals, animals, mystical creatures etc) to look after the land) that connect community to their local environment. [Gavin et al. \(2015, p. 141\)](#) defines biocultural approaches to conservation as ‘Conservation actions made in the service of sustaining the biophysical and sociocultural components of dynamic, interacting and interdependent social-ecological systems’. These principles incorporate and take into consideration the complexities of cultural and biological ethics, and practices in conservation, shifting the paradigm from ‘people centric’ to ‘nature centric’ goals and outcomes ([Gavin et al. 2015](#); [Lyver et al. 2019](#)).

From a Ngāti Rangi biocultural vision, a cultural monitoring framework, that considered a whole forest system and its

capacity to reflect significant values for Ngāti Rangi, was developed. Ngāti Rangi led the researchers in assigning culturally-significant themes and indicators and a gradient of ordinal scores was developed by the researchers, to assess current forest health, but also changes in forest health over a historical timeframe (70 years). To understand whether there had been intergenerational shifts in forest health, we asked *kaumātua* and *ngā tāngata tiaki* from the different age cohorts (>50-years and <50-years) to use ordinal indicators to score perceptions of historical and contemporary forest health states. This also enabled us to investigate how contemporary field evaluation of forest indicators compared with evaluations of forest indicators provided in interviews.

Materials and methods

Background

Ngāti Rangi are a tribal group of Māori located in the lower central North Island, with boundaries stretching from the southern base of Mount Ruapehu, through to the upper Whanganui river ([Fig. 1](#)). The people are part of the Whanganui *iwi* that descend from the ancestor, Paerangi, and identify to him through the *pepeha* (introduction that incorporates ancestry and history of individuals): *Ko Ruapehu te maunga* (Ruapehu is their mountain); *Ko Ngā Turi o Murimotu te maunga tapu*, (Ngā Turi o Murimotu is their sacred maunga); *Ko Whangaehu te awa* (Whangaehu is their river); *Ko Ngāti Rangi te iwi* (Ngāti Rangi is their tribe). (The tribe is located within and extends through the tribal boundary areas shown in [Fig. 1](#)).

This research project was commissioned by Ngā Waihua o Paerangi Trust, under the Ngāti Rangi environmental operational division, Te Ao Tūroa (the tribe’s environmental entity) in 2017. The Ngāti Rangi community panel, Ngā Pou Taiao, is the community forum for reporting directly to the Ngāti Rangi tribal members, this comprised of *pāhake* (*marae* (Māori community gathering place, consisting of several buildings, centred around a main meeting house) based representatives or elders) and *kaumātua* who are knowledge holders in these specific areas.

Developing a Ngāti Rangi biocultural vision

A mixed methodology was used to record and disseminate the information and data collected for this research. Two *noho taiao* (*marae*-based workshops) were held with 54 Ngāti Rangi *kaumātua* and *pāhake* who had been identified by the Ngā Pou Taiao (Ngāti Rangi’s Environmental Resource Manager) as holders of *mātauranga* (Māori knowledge) associated with their local forests. Each *noho taiao* was attended by David Leigh, an illustrator tasked with capturing key cultural themes and indicators, species and narratives that were of significance to the community.

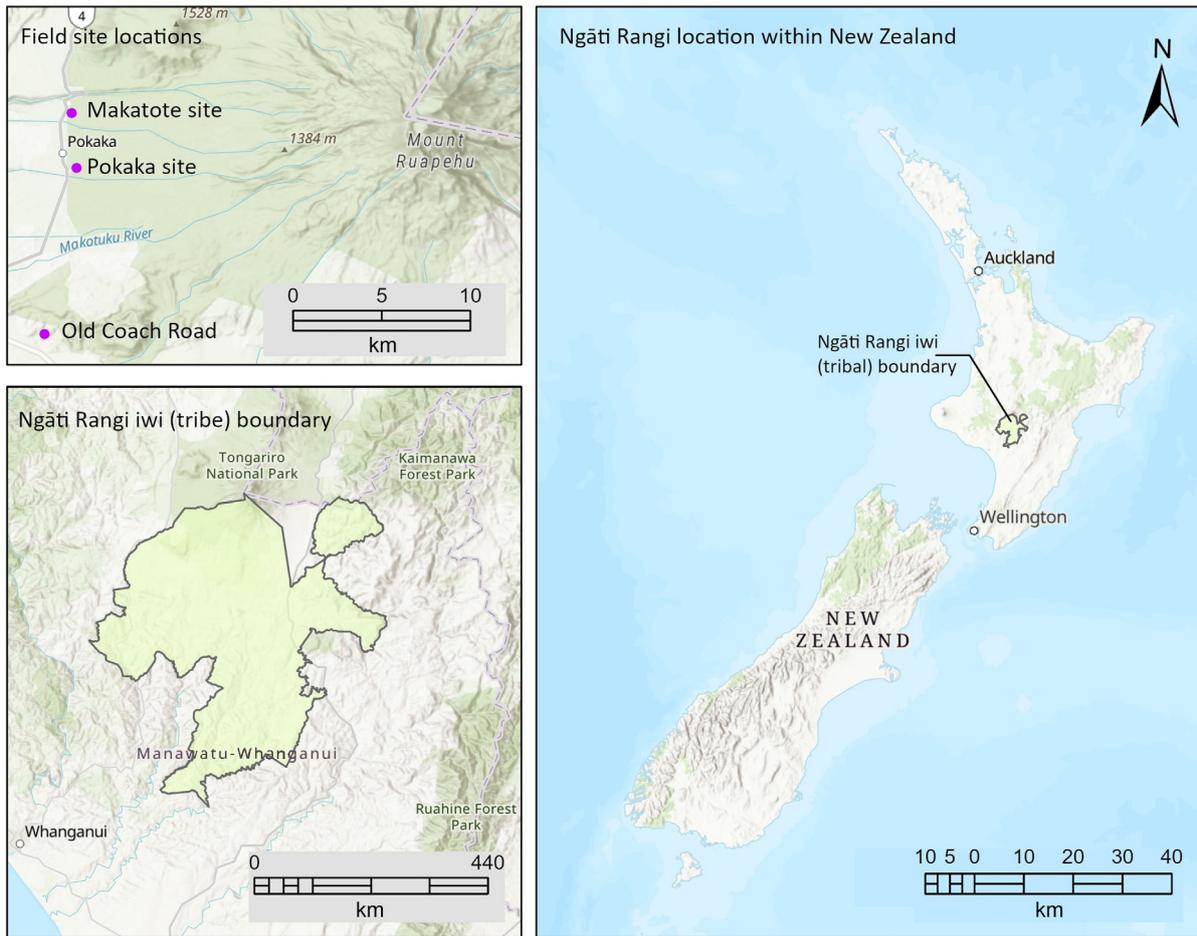


Fig. 1. Tribal territory of Ngāti Rangi and the three forest monitoring sites (Makatote, Pōkākā and Old Coach Road), North Island, Aotearoa-New Zealand.

These were then transformed into a poster format and are displayed within their offices for information and enjoyment for all the community. This information formed the basis of Ngāti Rangi Biocultural Vision, a summation of these posters is shown in Fig. 2.

Cultural monitoring framework

Using the information from the Biocultural Vision posters, two Ngāti Rangi *ngā tāngata tiaki* selected by the Ngā Pou Taiao then reviewed the posters and identified five key cultural themes based on their knowledge of the environment and the traditional uses associated with the environment (Awatere et al. 2017), to develop a cultural monitoring framework to assess the health and condition of their local forests. Key cultural themes within the framework included: *rongoā* (medicinal resources), *manu* (birds), *ahua o te ngāhere* (nature of the forest), *wai* (water), and *tāngata* (people) (Fig. 3).

Using information provided by *kaumātua* and *pāhake* at the *noho taiao*, forest indicators were assigned to each of the five cultural themes within the community monitoring

framework. How these indicators were observed and expressed by *kaumātua* and *pāhake* was utilised to inform the monitoring questions, and a gradient of ordinal rankings was applied to each (Table 1). The draft framework was then presented back to the Te Ao Tūroa, who worked collaboratively with their Ngā Pou Taiao forum. The forum gave feedback on the draft framework; this was revised, then formatted into a field sheet for testing.

Ngā tāngata tiaki surveys of contemporary forest health

A select group of Ngāti Rangi *ngā tāngata tiaki* were identified based on criteria including: those who grew up using the forest for cultural purposes, or held cultural knowledge about practices that had been passed down to them, or who had worked within the forests. These *ngā tāngata tiaki* led the development, provided feedback and trialled the paper and digital framework application of the tool. Ages ranged between 18 and 49 years ($n = 7 < 50$ years, three female (F), four male (M)), which became the age range groupings for our

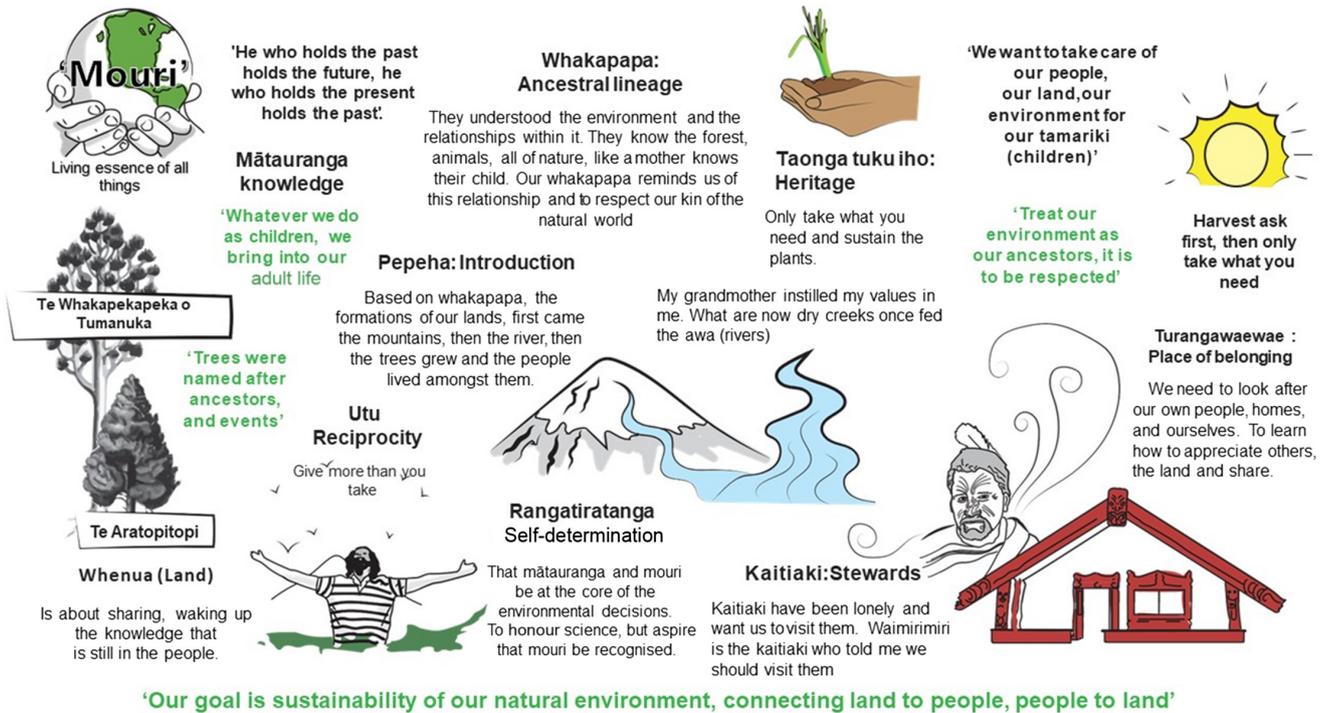


Fig. 2. Key cultural themes within Ngāti Rangi’s Biocultural Vision that formed the basis of their forest monitoring program in North Island, Aotearoa-New Zealand.

survey categories, which is under 50 years and over 50 years. The surveys were conducted from August 2019 to May 2021 with two individuals surveying every year and those who were trained and available making up the participant numbers. Not all survey sites are reported here, due to inconsistencies in the data over the 3-year period.

These *ngā tāngata tiaki* were selected by the Ngā Pou Taiao to test the survey on current forest health. Three forest sites were selected for the survey, based on accessibility, cultural importance and current tribal usage. The three sites were Makatote, Pōkākā and Old Coach Road. Surveying was undertaken at randomised locations within the three sites. At each location, *ngā tāngata tiaki* led the researchers along their known trapping, hunting and public tracks (which acted as a survey line) into the forest for a minimum of 20 min (maximum of 4 h). These were key spots of significance identified by the Ngā pou taiao, e.g.: *rongoā* spots, bird roosting/nesting locations, animal hunting spots etc. Once at the survey sites, *ngā tāngata tiaki* discussed the questions and articulated how they understood the metric measure, for the scoring process. Researchers asked *ngā tāngata tiaki* not to disclose ranking scores to each other to limit participant bias or influence on each other while scoring.

Makatote (175°23'34.01"E and 39°21'52.01"S) is predominantly podocarp–broadleaved native forest. It is around 2500 ha and currently includes part of the Pōkākā Eco-sanctuary now within the owned and managed *rohe* (tribal district) of Uenuku (a neighbouring tribe) as well as

the Makatote Viaduct located between Ohakune and the national park. Previously managed by DOC (New Zealand Department of Conservation), after Treaty settlement claims it has returned to *Iwi* ownership and management.

Pōkākā (175°23'29.45"E and 39°17'30.95"S) is a mixed beech and podocarp native forest stand located to the south of the Makatote site and is included in the above mentioned Eco-sanctuary. The Pōkākā site is accessed over the old western line tramway, which was reopened to the public in 2006. The tramline moved products such as timber, cattle and sheep to processing plants and ports for export. Many industry artefacts, historical buildings and *waahi tapu* (sacred sites) occupy the site. It was closed as a station in 1965, with complete public exclusion from 1971.

Old Coach Road (175°22'45.33"E and 39°21'53.01"S) is a mixed podocarp and *tawa* (*Beilschmiedia tawa*) stand located further south of Mt Ruapehu than the two other sites. This includes a 100-year-old regenerating bush area that is co-managed by Ngāti Rangi through Ngā Waihua o Paerangi trust and DOC. This site is frequently accessed and utilised for various leisure activities (tramping, biking, hiking, walking etc.). It is set back from the main highway and accessed by a public bike trail that runs through it, with colonising *mānuka* (*Leptospermum scoparium*) foliage around the edges, and a 20+ year regenerating mixed conifer (Podocarpaceae) forest. There are dense populations of native *mamaku* (*Sphaeropteris medullaris*) and *ponga* (*Alsophila dealbata*) tree ferns providing this site with an

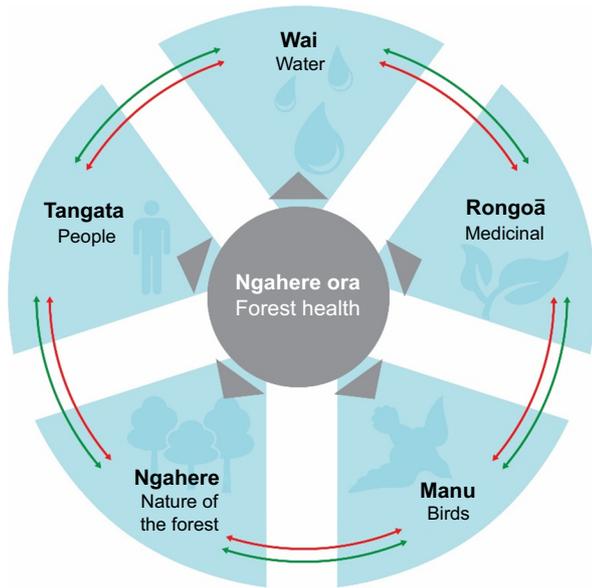


Fig. 3. Cultural framework used by Ngāti Rangī *ngā tangata tiaki* (environmental guardians) to structure their community-based monitoring system to assess forest health and condition. Arrows indicate the relationship between each construct and their intrinsic interconnection with each other.

open canopy, comprised of mature trees with thick dense undergrowth foliage.

Kaumātua interviews of long-term forest health

Oral interviews and community *wānanga* (workshops or dialogue processes held in 2018 to 2020) were used to build a historical narrative on forest health in the Ngāti Rangī tribal territory, and to visualise trends in forest condition over time. For the purposes of this study, *Kaumātua* and *ngā tāngata tiaki* were identified by the Ngā pou taiao as being the Elders ($n = 3 < 50$, 1 F, 2 M; $n = 6 > 50$, 3 F, 3 M) who lead initiatives, live and are active in the Ngāti Rangī forests. *Kaumātua* were interviewed using the community-based monitoring questionnaire (Table 1) to portray a decadal visualisation of the state and condition of the forests over 90 years (1930–2020). The age of *kaumātua* ranged from 57 to 81 years, which became the second age range category. For each survey question, *kaumātua* were asked to share their earliest memories of the indicator and score it using the gradient of scores provided, those *kaumatua* who were able were part of the field test monitoring, and those who weren't were interviewed within their homes/or in a comfortable place. Each *kaumatua* was then asked to score each indicator on a decadal basis up until the present day.

Analysis

Ordinal scores for the cultural indicators were provided by seven Ngāti Rangī *ngā tāngata tiaki* across three years for

each of the three sites. Scores were aggregated across year and grouped by site, with mean scores for 15 indicators also calculated. The historical interview responses for cultural indicators provided regional indications of the state of forest health changes over time, according to the *kaumātua* and *ngā tāngata tiaki*. Ordinal scores assigned by six Ngāti Rangī experts aged 50 years and above were grouped into decadal responses.

Results

The ability of Ngāti Rangī to articulate their aspirations and decision making for their environment is the expression of *rangatiratanga* – the ability to self-determine systems and approaches as shaped by their own cultural world view.

Cultural themes and indicators of forest health

Key cultural themes to measure forest health revealed by Ngāti Rangī included *rongoā* (medicinal), *manu* (birds), *ahua o te ngāhere* (nature of the forest), *wai* (water) and *tāngata* (people) (Figs 2 and 3). Although ecologically based in their broad categorisation, these themes used a range of indicators to determine forest health and the relational connections between Ngāti Rangī and their forests.

The understandings of these themes, as defined by the *ngā tāngata tiaki* and *kaumatua*, are shown in Supplementary material S8.

Examples of how some of the cultural themes were expressed and understood through our trials follows.

Whanaungatanga (Question (Q)14, 15) the notion of being part of a larger group, which imbues one with the sense of cooperation and reciprocity, of obligation and commitment to the other individuals in a kinship group. It is a relational or family-like connection between blood relatives and non-blood relatives. The Ngāti Rangī understanding in this context was the ability to practice '*taonga tuku iho*' – sharing of knowledge through the generations from the sharing of tribal practices of living and being, such as the *maramataka* – lunar calendar, which is specific to place, *rāhui* – active no-touch restrictions on resources for recovery and protections purposes and *wānanga* – learning language and traditional tribal ways in established cultural spaces (e.g. *marae*, forests, mountains and rivers etc.).

Rongo (Q13) or the smell of the *wai* (water) in the forest was a key indicator of health, taken to give an indication of the vitality of the living force of the forest:

You saw me sniff, that is what it is about it is the smell. (Full quote in S1). (Whaea Olive Hawira, pers. comm., Nov 2019).

The most important thing in the bush is the moss and the lichen, *ko rātou ngā tuākana* (they are the seniors). You can

Table 1. Key cultural themes, their associated indicators and ordinal scores and descriptions used to assess forest health by Ngāti Rangi *kaumātua* (elders) and *ngā tangata tiaki* (tribal experts) from the central plateau region of the North Island, New Zealand.

Cultural themes	Cultural indicators	Ordinal scores Māori	Ordinal scores English	Ordinal score descriptions	
<i>Rongoā</i> (medicinal plants)	1 – Is this a known site for <i>rongoā</i> ?	1 <i>Āna</i>	Yes		
		0 <i>Kaore</i>	No		
	2 – Are there weeds present?	1 <i>Āna</i>	Yes		
		0 <i>Kaore</i>	No		
<i>Manu</i> (birds)	3 – Are <i>taonga</i> species present?	1 <i>Āna</i>	Yes		
		0 <i>Kaore</i>	No		
	4 – Are insects present or can you see any evidence of them in this place? e.g. browsing, nests etc	1 <i>Āna</i>	Yes		
		0 <i>Kaore</i>	No		
	5 – Is the voice of the <i>Ngahere</i> strong and full of life?	4 <i>Nui</i>	Abundant	The forest flourishing with diverse and <i>taonga</i> species (<i>manu</i>) that are abundant and thriving	
	3 <i>Pai</i>	Good	The forest is intact with minimal impact from pest species, <i>taonga</i> species are present		
	2 <i>Ahua Pai</i>	Ok	The forest has limited diversity with obvious impact from pest species, <i>taonga</i> species are present but not thriving nor abundant		
	1 <i>Iti</i>	Small or not significant	The forest has limited diversity with significant impact from pest species, <i>taonga</i> species are scarce		
	0 <i>Aue</i>	Not great	The forest is severely limited with significant impact from pest species, no <i>taonga</i> species are present		
<i>Ngahere</i> (<i>Ahua o te ngahere</i> : the nature of the forest)	6 – Is the <i>Ngahere</i> floor flourishing?	4 <i>Nui</i>	Abundant	(Look around, what can you see?) The <i>ngahere</i> floor is covered in dense leaf litter and debris, ferns, fungi and moss are abundant, the small shrubs and seedlings are diverse and abundant	
		3 <i>Pai</i>	Good	The <i>ngahere</i> floor is covered in dense leaf litter and debris, ferns, fungi and moss are present but less abundant, small shrubs and seedlings are not as dense nor diverse	
		2 <i>Ahua Pai</i>	Ok	The <i>ngahere</i> floor is covered with leaf litter and debris, fungi and moss are scarce, small shrubs and seedlings are spread out and scarce	
		1 <i>Iti</i>	Small or not significant	The <i>ngahere</i> floor is limited with leaf litter and debris, no sign of fungi or moss, any small shrubs and seedlings are dominated by two to four species	
		0 <i>Aue</i>	Not great	The <i>ngahere</i> floor is severely limited with leaf litter and debris, no sign of ferns or juvenile trees. It is dry and feels impoverished.	
	7 – Are there canopy layers present and thriving?				Can you see different bush tiers or tree layers e.g.: canopy, mid layers, <i>totarāhoe</i> ? Are the tree's foliage flourishing and thick, are there <i>rakau</i> supporting other plants?
		4 <i>Nui</i>	Abundant	The <i>ngahere</i> tiers are clearly visible, diverse species are presently thriving and abundant.	
		3 <i>Pai</i>	Good	The <i>ngahere</i> tiers are somewhat present and diverse.	
		2 <i>Ahua Pai</i>	Ok	The <i>ngahere</i> tiers are few and limited with limited diversity.	
		1 <i>Iti</i>	Small or not significant	The <i>ngahere</i> tiers are thin and letting light and wind through, little to no diversity	
0 <i>Aue</i>		Not great	The <i>ngahere</i> tiers is severely limited with large clearings		
	1 <i>Āna</i>	Yes			

(Continued on next page)

Table 1. (Continued).

Cultural themes	Cultural indicators	Ordinal scores Māori	Ordinal scores English	Ordinal score descriptions
	8 – Are there significant trees present? Why are they significant? – list	0 <i>Kaore</i>	No	
	9 – Are any trees displaying symptoms of disease?	1 <i>Āna</i> 0 <i>Kaore</i>	Yes No	
	10 – Is there evidence of animal browsing?	1 <i>Āna</i> 0 <i>Kaore</i>	Yes No	
	11 – Do <i>taonga</i> species have a suitable habitat to thrive?	4 <i>Nui</i> 3 <i>Pai</i> 2 <i>Ahua</i> <i>Pai</i> 1 <i>Iti</i> 0 <i>Aue</i>	Abundant Good Ok Small or not significant Not great	The habitat capacity is very strong and diverse with very minimal impact from pest species, <i>taonga</i> species are presently thriving and abundant The habitat capacity is strong but less diverse with some impact from pest species, <i>taonga</i> species are present The habitat capacity is limited with moderate to heavy impacts by pest species, very few <i>taonga</i> species are present The habitat capacity is limited with significant impact from pest species, <i>taonga</i> species number less than three species of <i>manu</i> The habitat capacity is severely limited with significant impacts from pests and exotic species, no <i>taonga</i> species are present
<i>Wai</i> (Water) (its presence within the forest to maintain the wellness of the forest)	12 – How would you consider the <i>mouri</i> of the site?	3 <i>Mouri ora</i> 2 <i>Mouri piki ake</i> 1 <i>Mouri oho</i> 0 <i>Mouri 'te rongo</i>	Healthy life essence Ascending life essence Awakening life essence Revealing or uncovering life essence	Using your observational senses how does the water (i.e. dampness) of the forest feel or smell, its presence or absence in the forest The <i>mouri</i> (life force) of the <i>wai</i> (water) is flourishing, the forest smells and feels damp and key <i>taonga</i> species are abundant The <i>mouri</i> of <i>wai</i> is expanding, the forest smells damp and key <i>taonga</i> species are present. The <i>mouri</i> of <i>wai</i> is improving, the forest has no damp smell and key <i>taonga</i> species are scarce. The <i>mouri</i> of <i>wai</i> is inactive, the forest feels and smells dry and key <i>taonga</i> species are absent
	13 – What is the <i>rongo</i> of the <i>wai</i> in the <i>ngahere</i> ?	3 <i>Mouri ora</i> 2 <i>Mouri piki ake</i> 1 <i>Mouri oho</i> 0 <i>Mouri 'te rongo</i>	Healthy life essence Ascending life essence Awakening life essence Revealing or uncovering life essence	Using your observational senses how do you see/smell/feel the vibrancy of the <i>mouri</i> at this site? The <i>mouri</i> is flourishing and key <i>taonga</i> species are abundant (<i>manu</i> (birds)/ <i>rakau</i> (trees) etc.) The <i>mouri</i> is expanding and key <i>taonga</i> species are present The <i>mouri</i> is improving and key <i>taonga</i> species are scarce The <i>mouri</i> is inactive and no key <i>taonga</i> species are present
<i>Tangata</i> (People) (their cultural interactions and non-cultural impact on the forest)	14 – Can <i>whānau</i> participate effectively in <i>manaakitanga</i> ?			The ability for <i>whānau</i> to support the wellbeing of both themselves and wider <i>whānau</i> is enhanced or diminished through the active use of the site for harvesting (<i>kai</i> (food) e.g. hunting, <i>rongoā</i> or weaving/decorative) purposes and can be shared daily and/or at functions like <i>hui</i> and <i>tangihanga</i> (cultural funeral practices). Activities can also incorporate

(Continued on next page)

Table 1. (Continued).

Cultural themes	Cultural indicators	Ordinal scores Māori	Ordinal scores English	Ordinal score descriptions
				<i>kaitiakitanga</i> (act of stewardship) (trapping/restoration projects) and recreational use e.g. bush walks, hunting etc.
		4 <i>Nui</i>	Abundant	Abundant <i>kai</i> /resource available, site is very actively and specifically used.
		3 <i>Pai</i>	Good	Sufficient <i>kai</i> /resource available, site is broadly utilised.
		2 <i>Ahua Pai</i>	Ok	Some <i>kai</i> /resource available and the site is moderately utilised.
		1 <i>Iti</i>	Small or not significant	Sparse <i>kai</i> /resource available and the site is hardly used.
		0 <i>Aue</i>	Not great	<i>Kai</i> /resource unavailable and the <i>whānau</i> don't use the site.
	15 – Can <i>whānau</i> participate effectively in <i>whanaungatanga</i> ?			<i>Whānaungatanga</i> in this instance is the ability to practise <i>taonga tuku iho</i> – intergenerational knowledge transfer, e.g. <i>maramataka</i> (lunar calendar), <i>rāhui</i> (harvesting or use restrictions), and <i>wānanga</i> (learning gatherings), etc.
		4 <i>Nui</i>	Abundant	Specific <i>mātauranga</i> is shared here often: e.g. <i>Rongoā</i> /weaving/ <i>karakia</i> (Incantations)/ <i>wānanga</i> etc. <i>mātauranga</i> and <i>tikanga</i> (customs, traditional practices) are shared with <i>whānau</i> at this site, it is regularly used for these practices this site.
		3 <i>Pai</i>	Good	Site known for <i>mātauranga</i> and <i>tikanga</i> sharing with <i>whānau</i> on occasion, <i>whānau</i> likely to come here to practise/share <i>mātauranga</i> here
		2 <i>Ahua Pai</i>	Ok	Some <i>mātauranga</i> and <i>tikanga</i> has been shared with <i>whānau</i> at this site, however infrequently but it is known to happen
		1 <i>Iti</i>	Small or not significant	Limited <i>mātauranga</i> and <i>tikanga</i> are shared with <i>whānau</i> at this site, it is uncommon to practise here
		0 <i>Aue</i>	Not great	<i>Tikanga</i> is not practiced or shared with <i>whānau</i> at this site

Table glossary: *taonga* – scared or treasured; *rakau* – tree, stick, timber or length of wood, *rongo* – scent, aroma or smell of water.

smell in a dry year the *pirau* (rot) of the forest because the moss is crying, because there is no moisture in there. That is the indicator. (Che Wilson, pers. comm., Nov 2019)

Another cultural indicator identified in assessing forest health was the ‘voice of the forest’ (Q5). Is it strong and full of life?

It has different voices dependant on the time of the day, dawn chorus is loud and noisy, then late afternoon its the insects *kihikihi* (cicada, Cicadoidea) and everything, then they peter off and the birds start up again. (Kaumatua Keith, pers. comm. Nov 2019)

At the inception of the surveys, *manaakitanga* (Q14) was understood to be the ability to harvest and share within the *whānau/hapū/hāpori* (section of kinship group) acknowledging the different scale of gatherings (e.g. immediate family, wider family members and various community meetings such as *tangi* (funerals) and *hui* (community meetings). As the *whānau* become more connected with the *ngāhere*, a more reciprocal relationship with the forest

(e.g. showing their ‘care towards the *ngāhere*’) was discussed. Through actions such as trapping and pest control, their sense of *manaakitanga* shifted from ‘me-centric’ to ‘forest-centric’ in the way participants framed their perspectives.

A traditional practice that was revived from the *noho taiao*, was the practice of walking in complete silence to an allocated site, (e.g. the forest lake), to enable deep connection and listen to the voice of the forest. The *ngā tāngata tiaki* would then *karakia* (recite an incantation) at the site and discuss the monitoring or what they had observed in the forest environment on the way.

Ngāti Rangi assessment of forest health

At the Makatote site, *ngā tāngata tiaki* felt that there was a moderate opportunity for the Ngāti Rangi community to participate in *manaakitanga* in Fig. 4 (indicator i 14) and *whanaungatanga* (i 15). This forest was ranked highest for these indicators. Makatote had more native insects (i 4), fewer weeds (i 2) and little evidence of animal browsing (i 10), greater forest floor regeneration (i 6), layering within the canopy (i 7), and stronger smell of water in the

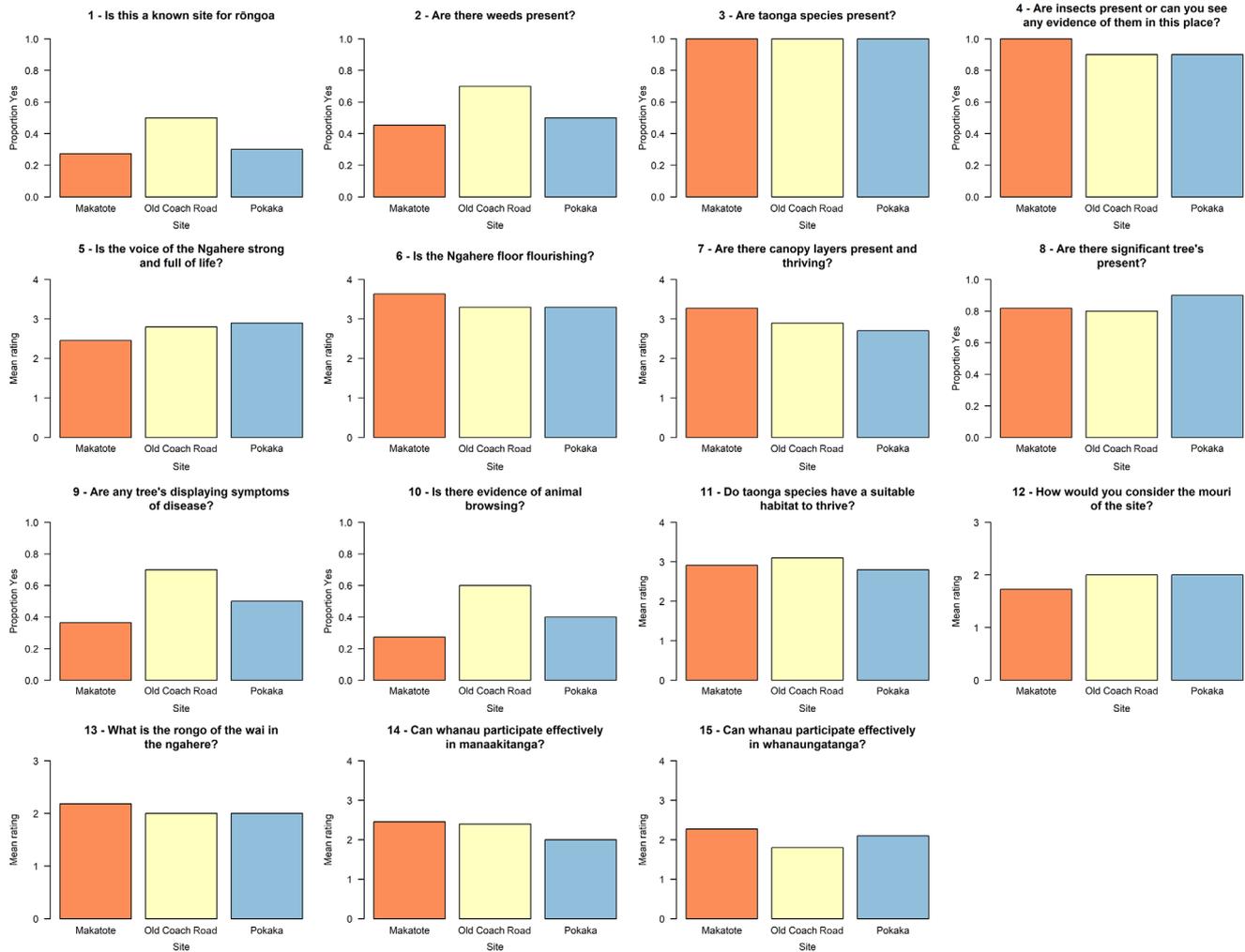


Fig. 4. Average proportions of ordinal scores for indicators assigned and used by *ngā tāngata tiaki* (tribal experts) to assess the health and condition of three forest sites (Makatote, Pōkākā and Old Coach Road) in the Ngāti Rangī tribal territory, North Island, Aotearoa-New Zealand.

forest (i 13) than the other forest sites. It also scored highly for providing a suitable habitat for *taonga* to thrive (i 11) and having significant trees present (i 8). The site received a moderate to strong score for *mouri* (i 12). However, *ngā tāngata tiaki* felt Makatote site was not well known for its *rongoā rākau* (i 1).

At the Old Coach Road forest site, *ngā tāngata tiaki* considered the *mouri* to be fairly strong (i 12), with a moderate opportunity for the community to enact *manaakitanga* (i 14). However, the capacity of the community to deliver *whanaungatanga* from this site was considered only fair to moderate (i 15). The Old Coach Rd site was the most well known for *rongoā rākau* (i 1) albeit only moderately – despite the presence of weeds (i 2), evidence for disease in the trees (i 9) and browsing by introduced animals (i 10) being the highest for any of the three sites. Broadly speaking, *ngā tāngata tiaki* scored the presence of (1) *taonga* species (i 3), (2) suitable habitat for *taonga* species to thrive (i 3), (3) insects

(i 4), (4) significant trees (i 8), and (5) canopy layers as moderate to high (i 7). The strength of the forest voice (i 5), growth across the forest floor (i 6), and smell of moisture in the forest (i 13) was also considered to be moderate to high.

At the Pōkākā site, *ngā tāngata tiaki* felt there was only a limited opportunity to participate in *manaakitanga* (i 14) and *whanaungatanga* (i 15), despite there being a moderate sense of *mouri* (12) in the forest. Pōkākā was not well known for its *rongoā rākau* (1), even though the forest scored moderate to high ratings for the presence of (1) *taonga* species (i 3), (2) suitable habitat for *taonga* species to thrive (i 11), (3) insects (i 4), (4) significant trees (i 8), and (5) canopy layers (i 7); having a strong voice (i 5) and smell of moisture (i 13); and a flourishing forest floor (i 6). The presence of weeds (i 2) and evidence of disease (i 9) and animal browse (i 10) was also considered low to moderate.

Overall, the ecological indicators of health of the forests (e.g. presence of *taonga* species (i 3), insects (i 4), overall

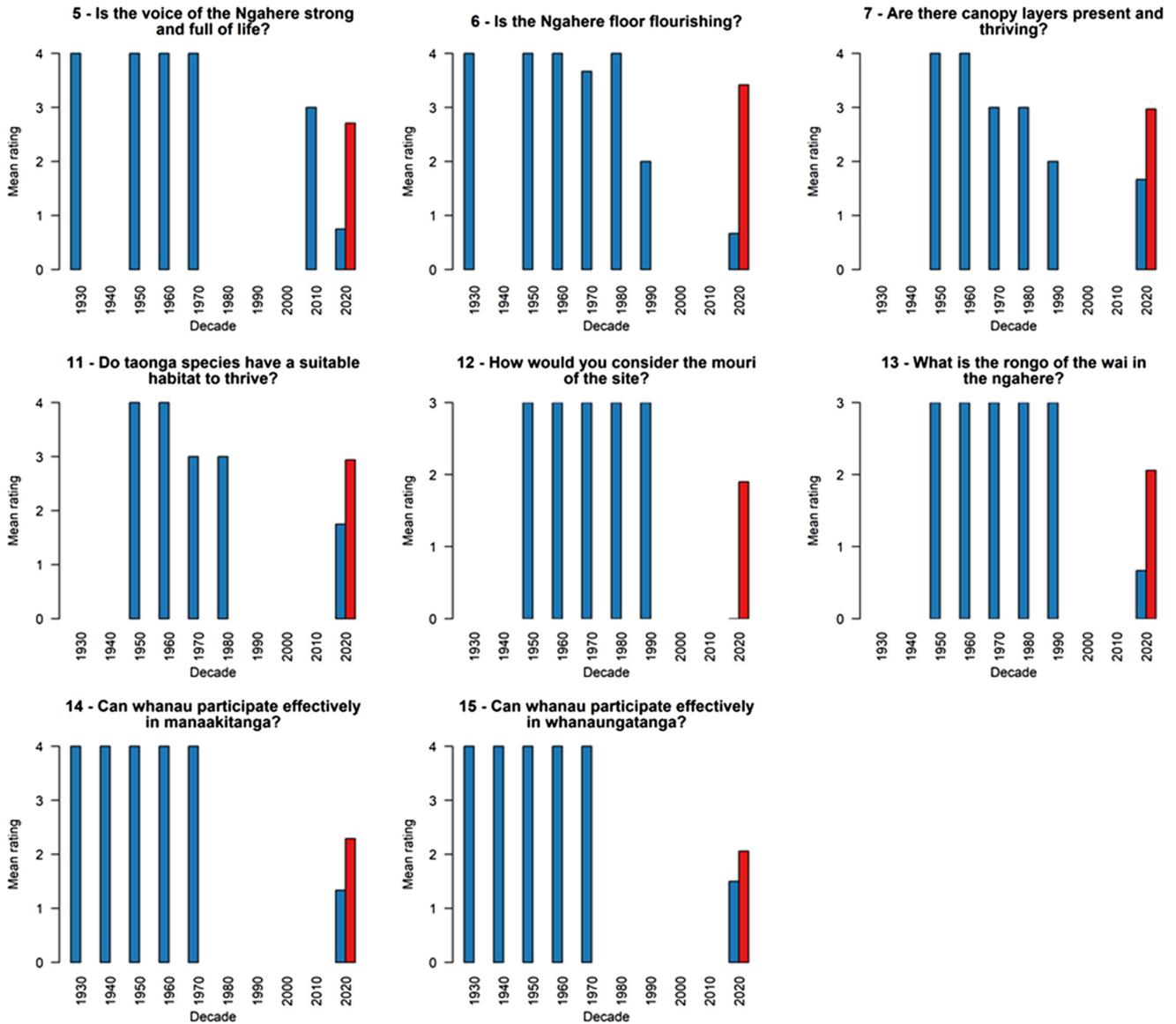


Fig. 5. Decadal average ordinal scores assigned by Ngāti Rangi kaumatua (elders; dark blue bars – interviewees) to indicators of forest health from across the Ngāti Rangi tribal territory, central North Island, Aotearoa-New Zealand. Red bars (far right within each subplot) represent average scores provided by Ngāti Rangi ngā tangata tiaki (tribal experts) from field monitoring at the three forest sites Makatote, Pökākā and Old Coach Road.

forest strata – from the forest floor (i 6) right up to the top canopy layers (i 7), with an abundance of flora and fauna diversity (i 3, 4, 5, 6, 7, 8, 11), suggest that these three forests were in moderate condition.

Assessment of historical change in forests

Ngāti Rangi kaumatua felt that a number of biophysical and cultural indicators (e.g. voice of the forest (i 5), forest floor regeneration (i 6), smell of water (i 13), showed that health and condition of the forest began to decline from the 1970s (Fig. 5). Whilst there were large gaps in scores

over the 1990s, 2000s and 2010s, kaumatua scored all biophysical and cultural indicators much lower in 2020 than for the same areas 30–90 years ago (Fig. 5). Younger ngā tangata tiaki were much more positive in their combined assessment of these indicators across the three forest sites in surveys.

Discussion

Kimihia te hōhonutanga o tō tātou Māoritanga i roto i to tātou Atuatanga

Kumea ake ki runga ki Te waka-o-te ora

Pursue the depths of our culture within our spirituality

Place what you find upon the vessel that gives you life.
(Che Wilson 2021)

Across the three forest sites, *ngā tāngata tiaki* felt that the biocultural indicators indicated moderate health, whilst the more ecological-based indicators, indicated moderate to strong levels of health. *Mouri* as a cultural construct was assessed as being moderately strong at all sites, suggesting the vigour of life at the sites was in a healthy thriving condition. *Manaakitanga* and *whanaungatanga*, the other cultural measures of importance to Ngāti Rangi, also indicated that there were moderate to good opportunities for *whānau* to be engaged and enact their cultural practices on a regular basis. Although Old Coach Road was considered to have moderate opportunities for collecting *rōngoā rākau*, it also scored the highest for weed and disease presence, and animal browsing. Age-related differences in how forest condition was scored indicated evidence for an inter-generational shift in how the forest is perceived and understood, for example what is considered to be healthy, thriving or good forest health now, may be 'poor forest health' in the past or in *kaumatua* younger years. However, the impressions of the *kaumatua* and *ngā tāngata tiaki* indicated that the forest health had declined over the past 30–40 years.

Monitoring towards a biocultural vision

Within each of the cultural themes and metrics Ngāti Rangi used for measuring forest health, underpinning cultural concepts such as *manaakitanga* and *whakawhanaungatanga* are intrinsically expressed throughout. For Ngāti Rangi the *whakapapa* of sacred forests is the systematisation of ancestral links to every species within forests. Several of the indicators were chosen to identify various aspects of the cultural links in forests, for example; in asking the question: Are there significant trees present? How *whakapapa* is understood here is encapsulated in the community discussions on a sacred tree for the Ngāti Rangi *whānau*. The trees identified through this indicator hold various *whakapapa* on families who were associated as the stewards of the tree, bird, insects, vegetation and fruits, and the intricate connections of all these different aspects. Similar relationships have been observed in other Indigenous cultures (Maffi and Woodley 2012). For example, the Bamenda Highlands tribal communities in Africa highly regard the Bannerman's Turaco bird (*Tauraco bannermani*), which holds the peoples' genealogical connections to the endemic biodiversity and local cultural practices. Another example is the Gamo people from south-western Ethiopia (Maffi and Woodley 2012), whose sacred sites retain their genealogy

with regards to worship, natural forests, burial grounds and other natural landscape features. Natural landscapes and the subsequent biodiversity hold the historical lineages of peoples, places and species that retain the community genealogy of place. The importance of place and connection to place is considerable for Ngāti Rangi in biocultural conservatorship, therefore there is a strong requirement for indicators that reflect those values.

Embodied in the Ngāti Rangi vision is connection to place, which provides place-based solutions. These encompass their cultural ways of being, knowing and doing, based on the geographical place from where they are derived. Cultural knowledge echoes the origins of place, as an integral part of being connected to place, capturing the local dialect, names of places and species, and landscape narratives which hold their historical accounts (Maffi and Woodley 2012). For *Māoridom*, *karakia* (prayer and incantation) must take place before all cultural activities. This is recited to connect the spiritual to the physical realm, and it is foremost in facilitating connection to place and space (Barlow and Wineti 1991; Moon 2005). *Karakia* is used as a mechanism of transition in this instance, from the contemporary physical world (which includes modern living, devices and ceaseless communication modes), into the natural world (commonly, out of internet range and off grid). *Karakia* is seen as a petition, plea or prayer to the *atua* (gods) to find favour in the activities that are about to be conducted, in this context. Tāne Mahuta is the god of the forests and all its associated beings (birds, insects, trees, shrubs, mosses, fungi and mammals) (Barlow and Wineti 1991; Moon 2005). It is used as a means to listen, and to maintain a deep connection to place and the environment you are moving into.

..... we would have *karakia* in the carpark, whakapiri (gather together). (full quote in S2). (Deb Te Raki, pers. comm., 2019)

Ngāti Rangi as a tribe hold many *whare wānanga* (traditional schools of learning) including the 'Tira Hoe Waka' (A sacred journey of connection) for the descendants of the Whanganui River. This tradition spans 34 years and connects those descendants who have not seen ancestral sites along the river, and stories of their families, to maintain a strong connection to place. These practices epitomise concepts that align with biocultural practices and preserves their relationships between humans and nature (Plieninger et al. 2015; Lyver et al. 2016, 2019; Sato et al. 2021).

The monitoring tool supported this transferral process through the *noho marae* and workshops that were held at each place to develop and test the framework. Another facet of the tool to collect and communicate oral histories was its transferral into a mobile application to record the images and the stories from Elders and active younger generations in the *ngāhere*. For the *whānau* of Ngāti Rangi,

this facilitated not only reclamation of their knowledge systems and spaces, it was a means of gathering historical narratives as well as quantitative cultural data (Younger 2021).

.. because we have lost that skill, ... (Full quote in S3). (Anonymous, pers. comm., 2020)

Providing data on cultural aspects relevant to traditional practices is essential for not only regenerating *mātauranga* but also adapting it to current practices and the challenges. As an example, the naturalisation of introduced animals as the new sustenance economy (e.g. feral pigs, *Sus scrofa*; deer, *Cervus* spp.; feral goats, *Capra hircus*). Also, the revival of *mātauranga* associated with plants for consumption and medicinal use has increased with active engagement in the forest. Adapting *mātauranga* to mitigate the harm of introduced species and improve forest health provides the opportunity for *ngā tāngata tiaki* to engage back with their forests. A biocultural monitoring tool is one facet that Ngāti Rangī can use to reconnect, reclaim and build new knowledge around their forest. This mechanism explicitly supports the Ngāti Rangī vision to grow tribal knowledge of their people across landscapes.

Our indicators identify aspects of *kaitiakitanga* that can be observed and measured in action such as participating in *manaakitanga* and *whanaungatanga*. These activities require regular and ongoing interaction within the environment in a reciprocal approach in caring for the wellbeing of the natural landscape. The reciprocal relationship that mutually exists between humans and the environment is well documented (Marsden and Royal 2003; Sterling *et al.* 2017; Lyver *et al.* 2019; McKemey *et al.* 2019; Reihana *et al.* 2019; Thompson *et al.* 2020). Acting as *ngā tāngata tiaki* is to promote the welfare and health of the earth; *manaakitanga* is the sharing and harvesting of the bounty the earth provides and *whanaungatanga* is the passing on the traditions and knowledge around how to best action these practices. These are are empowering *kaitiakitanga*.

I think in terms of *manaaki tangata* and *manaakitanga* our *ngāhere* ... (Full quote in S4). (Olive Hawira, 2020)

The indicator scores used in this study are just the beginning in an effort to develop the best picture of forest biodiversity and community health for Ngāti Rangī. These scores have started to form a baseline representation of the health of these three forests, based on these biocultural tools. They have anecdotally provided a cultural use and resource appropriation illustration for Ngāti Rangī. Here we can observe an understanding of how *manaakitanga* is informing current forest ecology practices and its use to inform future cultural practices and decision making. Overall these scores provide a first glance at the forest health from a cultural perspective, highlighting that the ecological

health is in a relatively good state, whereas the cultural indexes were recorded at a magnitude level lower state.

A future aspect to be considered is how the various indicator scores ‘fit together’ to provide an overall view of forest health. Support for collaborative knowledge partnerships in Wardell-Johnson *et al.* (2019) exemplify the positive trends for future forest management. Each indicator provides insight into one attribute of forest health and is considered in isolation, then holistically. Weighting of attributes’ contributions within the collective context and individually is common across Eurocentric environmental monitoring: the NZ Department of Conservation monitor a range of taxa across the public conservation estate, and reporting requires an overall assessment of the ecosystem health (Bellingham *et al.* 2020). This process is often subjective, relying on individual value judgements, and is generally carried out by senior staff members. More recent approaches have begun to look at multi-attribute expert elicitation approaches (Sinclair *et al.* 2015), which have the potential to be used. In this tool we utilise two cultural themes that assess the forest health in its entirety, for example *mouri* and *whanaungatanga*, these aspects can comfortably contribute to the overall assessment in forest health at the coarse and microbial spatial scales.

In a similar vein, Indigenous Peoples must wrestle with weighting and values judgment in assessing the health of their environment and its future data usage, transference and transmission. Traditionally conveying the understanding back to the community was held by *tohunga* (specialist experts) and the *kaumātua* of the *hapū* (sub-tribe) or *iwi* (tribe). These were the management and decision-making processes of the local cultural institutes, *te whare wānanga* (Marsden and Royal 2003; Jones 2013). Reinstating and recognising such *tohungatanga* (practising specialists) would re-establish a crucial cultural construct within *Māori* culture.

Refining the biocultural monitoring framework

For Ngāti Rangī this framework and tool provided the opportunity to have community discussions on what a forest health assessment and monitoring tool, developed using a biocultural approach, looks like for Ngāti Rangī. What is yet to be considered is how to mitigate shifting baselines across the generations, and whether that matters.

From evidence in Fig. 5, a shifting baseline of observation over time by the two age groupings was detected. As defined by Pauly (1995) and Knowlton and Jackson (2008) the baseline understanding of a habitat, species, or biome and its current setting is its state of health at a point in time. As demonstrated in Fig. 4, we see *ngā tāngata tiaki* who surveyed the forest were more optimistic of the condition of the forest than those who observed decline in the interviews of the *kaumātua* or older generations (Pauly 1995; Lyver *et al.* 2021), which were held away from the forest setting. This shifting baseline could reflect how each generation’s

observation of decline is grounded in their current time world experience. It may also reflect the abundance the older generation observed in the early 1950–1960s and earlier, which the younger generations never experienced. The older generation may thus see the decline in a more vivid comparison to their current known reality. Although the overall indicator averages obtained from participants on site were much higher than those from people who were interviewed elsewhere, we surmised that people's memory of the forest recalled in the interviews may also be recalling the forest in a worse or best-case scenario.

Although the young and old people in their families do have many opportunities to share knowledge in different forums such as the *tira hoe*, local *marae noho* are a consistent presence in their annual *whānau* calendars. Further development and understanding that has come from this tool and its evolution will be required. As with *mātauranga*, this tool is a living mechanism with which to facilitate the requirements of the *iwi*. This notion will allow future generations to incorporate knowledge flexibly.

Although it is critical to reclaim these cultural tenets and connections to the forest and live in unison with nature as per the practices of our ancestors, the reality and comfort of contemporary living is much more alluring. *Iwi* and *hapū* nationally are struggling to appeal to the next generations to elevate the value of these important relational connections to the environment. Connecting youth through media is one way that has emerged as a solution for the younger generations. Pairing technology with actual environment-based educational programs may offer a bridge in this gap (Reihana et al. 2019, 2021). Remote observation through a network of cameras and satellites may also be a temporary solution, and may at least provide a continuity of presence within these environments. This may facilitate contemporary solutions to current environmental issues and pressures in real time. Contemporary solutions now must be attempted to achieve these aspirations to reinvigorate the relational connections that as humans, we are all striving to maintain, in order to address the biodiversity crisis.

The robustness and significance of the data and information collected would benefit from larger sample size, such as more *ngā tāngata tiaki* or local *whānau* collecting information to get rigour from the information. With increased *ngā tāngata tiaki*, the overall health scoring system would benefit from diversifying monitoring locations to gain a wider extent of the forest footprint and strengthen its accuracy.

We need to consider other values that have been excluded, that could support forest health such as *utu* or reciprocity (Marsden and Royal 2003; Petrie 2013; Lyver et al. 2017; Reihana et al. 2021), between the forest and user. This concept was referred to under the indicator of *manaakitanga* and the shifting understanding of this concept evolved from *whānau* when they became aware of the forest reciprocity, not just in what it could provide for humans who use it but how they provided *manaakitanga* or

care back to the forest through activities such as pest control and weed management.

So, the expression of our land, and our *ngāhere*, and our rivers loving us with all of their energy (Full quote S6). (Keith Wood, pers. comm., 2020)

Mechanisms to achieve rangatiratanga (self-determination) and kaitiakitanga (stewardship)

Ngāti Rangī propose to use the information on the state and health of forests to inform local decision making and action. The community recognises the need for trend data that reflects a worldview and that Ngāti Rangī people can relate to, and trust. The biocultural framework will also provide a cultural perspective on current conservation practices and actions. In Australia, local policy was developed with Wik Way and Kugu people's traditional knowledge to inform tribal areas' pest control and management programs using traditional techniques in feral animal and pest management (Maffi and Woodley 2012). Although there is a strong desire for Māori to take the appropriate lead partner role with the Crown in co-governance and co-management of their natural resources, evidence suggests that this is a distant reality for Māori (Rainforth 2021). Māori refer to the foundational document the Treaty of Waitangi for restitution, however this process is yet to be realised. Financial equity for research on behalf of *iwi* stymies the ability for *iwi* to participate at full potential. Inequity between cultural ways of being exists across conservation socially, ecologically and spiritually.

Cultural constructs embedded into legislations such as *kaitiakitanga* in the Resource Management Act (1991) is another characteristic used to empower Māori in the conservation space. Although a number of constructs have been in legislation for many years e.g. section 4 of the Conservation Act (No. 65) (1987)(NZ), the interpretation of what this means in practice and the enactment on the ground is still to be elevated into an equitable position. It is still the Crown that is determining what it means 'to give effect to the Treaty of Waitangi' ... which is currently considered inadequate by *iwi*.

For Māori, *kaitiakitanga* is informed by traditional forms of community knowledge and expertise, which were held by *tohunga* or Elders who were trained and educated in the customary approaches and procedures, which guided community use and sustenance of natural resources. These specialists were the ultimate authority on natural resource use in the communities. However colonial intercession and repression has been persistent over time. From early settlement, acts such as the Native Land Act (1862) and the Tohunga Suppression Act (1907) applied colonial authority over cultural practices to assimilate Māori into mainstream European culture and repress their traditional cultural practices. The contemporary legislation and conservation

policies, such as the Conservation Act No. 65 (1987), Wildlife Act (1953), the Reserves Act No. 66 (1977), National Park Act (No. 66) (1980), and the currently under-reform Resource Management Act (1991), still maintain barriers for *iwi* to participate fully in the co-management of their natural resources (Spicer 2019; Rainforth 2021). Current reforms are attempting to address these concerns, however for Māori the status quo remains. To shift legislation and authority dominance from the colonial structure to a more sustainable Indigenous cultural socio-ecological approach will require the presence of biocultural monitoring tools, and cultural data to inform management practices for the future.

To date, current resourcing to enable initiatives such as this to be developed has had slow traction from governmental agencies. Whereas *iwi* have struggled to self-fund, these initiatives are in competition with government agencies who are fully funded to undertake research. The proposed *Te Mana O Te Taiao* (Department of Conservation 2022) provides an opportunity that is signalling a change to more equitable opportunities for *iwi* in mitigating the biodiversity crisis in New Zealand. However, if *ngā tāngata tiaki* are not adequately funded and current conservation management structures remain in place, then the neoclassical conservation systems and structures will remain as barriers for Māori attempting to reassert *rangatiratanga* and *kaitiakitanga*.

Cultural data can now be collected, translated and transferred into metrics that provide measures for intangible cultural concepts, and track the health and wellness of the environment over time (Tipa and Teirney 2006; Awatere *et al.* 2017). *Iwi* have meaningful data to contribute to environmental decision-making processes, as well as building the capacity to develop, collect and manage data. Intellectual property (IP) and data sovereignty for *whānau*, *hapū* and *iwi* is protected through this process (Māori data sovereignty principles: <https://www.temanararaunga.maori.nz/tutohinga>) Providing autonomy and empowering Indigenous People in knowledge and information to benefit their communities is key in developing metrics that reflect ways of being (Tipa and Teirney 2006; Awatere *et al.* 2017).

Implementing cultural monitoring systems

In Aotearoa, *Te Mana O Te Taiao* (Department of Conservation 2022) has an implementation plan that prioritises addressing the drivers of biodiversity loss. This strategy identifies the need for integrated approaches that incorporate *Te Ao Māori* knowledge and systems. Further, emphasis is on tools that can collect information to inform biodiversity protection, considering their environmental, social, cultural and economic impacts. The tool developed here is a step towards achieving these national goals (Department of Conservation 2022).

A key cultural mechanism in this study, which Ngāti Rangī utilises in species management, is *manaakitanga* (Table 1), here it is the ability to use a population (for example)

kererū to display their hospitality to visitors within their region, this was a sense of immense pride, as documented from the late 1880s up to the 1960s. However, due to a near extirpation of these populations, collection of this delicacy is now under a ban, and it is illegal for any Māori to harvest this resource. In this study we measure the ability for tribal members to be able to utilise resources in order to enact their cultural practice of *manaakitanga*, as seen in the results, across sites (Fig. 4) and over time (Fig. 5); the ability to perform this traditional practice over time has declined dramatically. Furthermore, understanding the implications of the state of the species from a cultural perspective and the availability of resources, we can link the impact it has had culturally on the Ngāti Rangī people. Biocultural approaches are aligned to these practices and are an opportunity to reverse not just ecological declines but socio-cultural impacts from colonial legacies.

National objectives such as *Te Mana o Te Taiao* explicitly references the desire to return the health of the natural world through mechanisms such as cultural monitoring tools. For example, it aims ‘to increase the integration of *Te Ao Māori* (the Māori world view) and elevate *mātauranga* Māori (Māori knowledge) in biodiversity decision making, management and funding’ (p. 5). Its central premise is to include people as a part of the cycle for restoration and conservation efforts instead of the historical view of humans as lords over the natural world (Department of Conservation 2022). This also aligns with the *Tiawaiwaka Te Ao Māori* conservation movement ‘Principle 2: Humans are not the centre of the universe’ (McGowan 2020). An Indigenous Peoples’ view of the world is now premising conservation; how this can be enacted is being investigated in multiple dimensions in Aotearoa and global conservation landscapes.

In accepting cultural monitoring mechanisms we need to consider the traditional land, resources and practices that are maintained in the contemporary context. One such method is *rāhui* (Memon *et al.* 2003; McCormack 2011; Fabre *et al.* 2021), where a temporary restriction is placed on utilising a resource to allow for recovery or purging of contaminants that it may have encountered (e.g. decline of resource; pollution or contamination of a species or site; death of an individual in a resource collection site). These existed historically and are now expressed in a contemporary manner.

Cultural monitoring systems such as these are contributing to land management practices globally. The Banbai rangers in Wattleridge Indigenous Protected Area (IPA) in Australia found that their traditional burn off practices provided higher habitat protection and better food forager opportunities, for the culturally-significant echidna, whereas the government led practices had more negative impacts on the habitat and changed the habitat resources (McKemy *et al.* 2019). In the Arctic, Inuit communities contribute to the Sustaining Arctic Observing Networks in developing an inventory to

develop a set of practical recommendations for conservation management. The value of the cyclic dynamics of the hunters who were recording their observations of the environment, has led to the improved understanding of the population dynamics over time (Johnson et al. 2016).

Kaitiakitanga or Indigenous guardianship systems for biodiversity and the environment, which are Indigenous people's worldviews, approaches and practices (Rozzi et al. 2006; Libby 2018; Hill et al. 2019), are aligned with 'biocultural approaches' (Maffi and Woodley 2012). Designing cultural monitoring frameworks and applying indicators that provide gradient measures that are trusted and make sense to local communities like Ngāti Rangī, provides the ability to enact cultural practices such as *Rangatiratanga*. Measurements of cultural, social and ecological constructs provide socio-ecological data that informs the decision-making process. Again, the Banbai Rangers used their cultural metrics to achieve a range of outcomes including conservation, cultural revitalisation, knowledge sharing and capacity development for the land management burn off practices (McKemei et al. 2019), putting their stewardship ethics into practice.

One of the things I've always been an advocate for is finding those cultural measurements and aligning them to the science stuff (Full quote in S7). (Keith Wood, pers. comm., 2020)

On a global scale the implications of this research support the enactment of Article 8 (j) of the *Convention on Biological Diversity* (1992), where traditional knowledge, innovations and practices are integral in combating the decline in biodiversity globally. The subsequent report – Local Biodiversity Outlooks 2 (Forest Peoples Programme 2020), highlights the critical roles IPLCs play in maintaining and enhancing ecological and cultural diversity in transformative change, and to realise the vision of the world living in harmony with nature. This study's findings support this international convention in combating biodiversity decline from a Ngāti Rangī perspective in their tribal territory.

Roles of *manaakitanga* and *whanaungatanga*

Overall the cultural indicators of *mouri*, *manaakitanga* and *whanaungatanga* ranked much lower than the ecological-based indicators in the cultural themes *Ngāhere*, *Manu* and *Rongoā Rākau* in measuring the forest health in the Ngāti Rangī tribal territory. However, they remained above average in their overall scoring from *ngā tāngata tiaki*. Although the cultural measures did not score equally with those ecological, this may allude to the Ngāti Rangī displacement from their tribal lands and the dilution of cultural practices that have occurred over time from colonisation.

Although the ability to enact *manaakitanga* and *whanaungatanga* were fair at the Pōkākā site, its forest edges consisted of weed foliage such as thistles (*Cirsium*

vulgare), blackberry (*Rubus fruticosus*) and dense bracken fern (*Pteridium aquilinum*). This site was also a known place for hunting introduced species of deer and pigs, these species replacing the traditional avian based sources and becoming the new *mahinga kai* (places for food gathering) for Ngāti Rangī. These introduced species are a modern conduit for fostering connection to place, through enabling *manaakitanga* (*Kai-hau-kai* – the sharing of wild food within communities) and *whanaungatanga* (togetherness and intergenerational knowledge sharing); the innate characteristic of men to hunt, gather and provide for family and community is being expressed in this context. What is now contended from naturalisation of these introduced species such as deer, goats and tahr etc. is the balance between their numbers for hunting and the destruction they cause if they are unmanaged in our wilderness. The key here is 'management' of these species in allocated areas as a preferred method, rather than unmanaged in sensitive and sacred areas.

Although the Old Coach Road site was regularly used for *rongoā rākau* collection, it was more readily accessible than the other two sites for general public use. The Makatote site, although right next to the main highway, had access issues and use was more restricted here. This study demonstrates how Ngāti Rangī use cultural values and lens to enact cultural concepts such as *manaakitanga* in conservation.

Through the active use of their forest sites, *whanaungatanga* is another concept which is stimulated once *whānau* are together in their natural landscapes. A strong sense of *whanaungatanga* is maintained within the tribe, this tool is another mechanism which supports this through *noho taiao*, and its continued use of the tool in maintaining their connection to their *ngāhere*.

High scores of forest health indicate a flourishing forest up to the period of the late 1980s to early 1990s (Fig. 5) with substantial opportunities to support a traditional sustenance economy. The long-term landscape history held in the Ngāti Rangī elders' memories records the land use legacies that are critical in contributing to contemporary ecological management of their forests (Plieninger et al. 2015). The sustenance economy that sustained tribal members and surrounding communities with relative ease up to this period, has been impacted by urban migration of tribal members into cities for employment. This migration began in the late 1950s with an exponential increase from the 1980s, which continues to this day. Interview responses did highlight the change in how the forest is used today in comparison to in the early 1920–1940s periods where their livelihoods were totally dependent on the environment in providing for their families. Ngāti Rangī observations of the changes over time were also associated with particular species that declined or became extinct over those periods, thus affecting the ability to enact cultural practices. An example is the ability to provide *manaakitanga* (through

local delicacies e.g. *kererū*) to large community events, even just for their families, due to the decline in the species.

Although cultural indicators such as *manaakitanga*, *whanaungatanga*, *mouri* etc. are usually considered indicators that are intangible and unmeasurable, we illuminated these socio-cultural aspects in order to link how the ecological impact has affected the cultural narratives and indicators over time (Plieninger *et al.* 2015; Sterling *et al.* 2017). Furthermore, barriers resulting from private ownership of lands and governmental management blocked access to Ngāti Rangi traditional lands and waters, resources, and sacred sites (Spicer 2019; Rainforth 2021). This meant that feelings of exclusion may have impacted how a site or species was assessed by *ngā tāngata tiaki* especially as those sites and species related to *manaakitanga* and *whanaungatanga*. Exactly what kind of impact this had was not captured as part of this study but would be worthy of future research.

Implicit to monitoring is the sustained process of assessing changes or threats in a habitat, ecosystem, biome or significant place over time (Sheil *et al.* 2015); an integral characteristic of monitoring is the presence of people within these ecosystems. For the Ngāti Rangi people the most successful way for them to monitor these forests is to maintain and increase the current occupation and participatory use that was practiced by ancestors. The cultural concepts used in this tool also elevate the Ngāti Rangi lens of the world and reflect cultural values, *iwi* vision and desires for a thriving *iwi* future (<https://ngatirangi.com/nga-mahi/strategy-or-te-ara-ki-te-moungaroa>). Creating such a tool supports a rigorous and objective assessment that fuses the traditional neoclassical monitoring model with an *iwi* world view.

With the tribe largely displaced from urban drift and re-location for employment, the traditional occupation and utilisation of their forests has declined. However, the sustained occupation of tribal lands by key Elders has maintained *ahikaa* (those who keep the fires burning in their ancestral lands) to continue their sharing of *mātauranga*, cultural practices and *kaitiakitanga* over natural resources.

Realising a biocultural vision

Kaitiakitanga – decision making informed by cultural indicators

The cultural indicators chosen here inform the biocultural vision for monitoring the Ngāti Rangi peoples' forests, these principles are cultivated from their natural ecospheres, the complex interactions within their culture, in and of their place.

Utilising *rangatiratanga*, tribal members have the right to make decisions on the health of their forest, natural environments (*mangai* (representative of), *wai* and *whenua* (land, earth)) and communities. To illustrate *rangatiratanga* by being autonomous as an entity, and people of place, this

tool provides information to facilitate such decision making in understanding the condition and how best to manage the tribal estate assets for the future.

In making those decisions they must understand the interrelated connections between all those living entities through their *whakapapa*, and the *whakapapa* of the forest. The significance of connections, to each other and within the natural world, which evokes active *kaitiakitanga* and the enduring *aroha* or love of the natural world.

The *whakapapa* connection has an expectation of reciprocation of which the provision of the resources is to be nurtured and sustainably used, in order to provide for future generations. This act of stewardship, as a right, is congruent with *turangawaewae* the connection to place, this place, that this tribe has, as people, which has been bequeathed by their ancestors. These understandings exemplify what a biocultural approach can look like in place.

Conclusion

This research support the conclusions of other studies (e.g.: (Maffi and Woodley 2012; Paul-Burke *et al.* 2018; Roue and Nakashima 2018; Winter *et al.* 2018; Lyver *et al.* 2019; Reyes-García and Benyei 2019; Ogar *et al.* 2020) that have pointed out that Indigenous Peoples' and their knowledge systems have a key role to play in reversing the decline in biodiversity globally, especially as communities demand innovative place-based solutions. Here we have provided evidence of an Indigenous framework that captures the state of the biodiversity and environment from the Ngāti Rangi *whanau*, this is both informative and trusted information by their communities. This has empowered the community, and supports their Ngāti Rangi tribal connection to place and cultural heritage, as exhibited by the *nga tangata tiaki* feedback on listening and taking time to connect with their forests. Moreover, these kinds of approaches provide cultural context for which local assessment and management of the environment can thrive. Ngāti Rangi and Indigenous Peoples globally are striving for equity to use their knowledge to inform management decision-making.

Biocultural monitoring systems, such as this one developed by Ngāti Rangi, have incorporated their cultural concepts to assist their people's connection to their tribal lands and provide an alternate Indigenous perspective of environmental condition. Here the definitions and meanings that have been portrayed are now described for future generations, this is *taonga tuku iho* (knowledge transferral) in action. It displays the depth to which *Te Ao Māori* consciously embed cultural concepts in their way of seeing, being and doing.

By its nature, we acknowledge that our biocultural monitoring tool is a living process, which will evolve as the local practitioners refine and adapt it for their specific purpose and future use.

Supplementary material

Supplementary material is available [online](#).

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Data availability. Data sharing is not applicable as no new data was generated or analysed during this study.

Conflicts of interest. The authors declare that they have no conflicts of interest.

Declaration of funding. The authors Kiri Reihana, Megan Younger, John Innes, Nicola Harcourt, Mahuru Wilcox and Hannah Rainforth were supported by the New Zealand Ministry of Business, Innovation and Employment contract Kiwi rescue project I617-23-019M. Phil Lyver and Andrew Gormley were funded by New Zealand Ministry of Business, Innovation and Employment Endeavour Fund, *Te Weu o te Kaitiaki – Indigenous Regeneration Pathways (C09X2104)* and Strategic Science Investment Funding for Crown Research Institutes.

Disclaimer. All images used in this publication were commissioned specifically for this publication. The location map describes the region and location of the *Iwi* involved.

Acknowledgements. We thank the all the participants involved with the project especially all the *whanau* who participated in the *Noho taiao marae* workshops, interviews and advisory contributions of the framework and monitoring mobile application. From Ngāti Rangi *whanau* we would especially like to thank Keith Wood, Fred Hawira, Olive Hawira, and Amoa Hawira for trialling and providing feedback on the framework. Additionally we would like to thank Deb Te Raki, Rangipai Wilson, Papa Willie and Nana Vera Wilson, Korti Wilson and Che Wilson. Finally we extend thanks to Deana Wilson, Pou Whirinaki and the Ngā Waihua o Paerangi Trust, for submission review of the manuscript. Our gratitude goes out to Arthouse designers Isaac Reihana and Colin Keegan who developed the mobile application NGAHEREora and the reviewed iterations to get it to the functioning point it is at today.

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