Indigenous knowledges of forest and biodiversity management: how the *watchfulness* of Māori complements and contributes to disaster risk reduction

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Abstract

The United Nations Sendai Framework 2015-30 for disaster risk reduction (DRR) reaffirms the role of Indigenous Knowledges (IK) as *complementing* and *contributing* to more effective DRR. This hard won space for IK comes as Indigenous communities voluntarily contribute to the local management of disasters, including wildfire and threats to biodiversity in forest ecosystems. The effectiveness of Indigenous practices in addressing hazards is based on traditional knowledges and empirical observations that inform active roles in environmental management. However, it is still not clear how IK complements and contributes to DRR. This article analyses interviews with elders, researchers, and community members and identifies how mātauranga Māori (Māori knowledge) on forests and biodiversity is embodied to inform Indigenous *watchfulness* as a tactical approach in contributing to more effective DRR strategies.

Introduction

Globally, forest ecosystems are under immense pressure from many decades of unsustainable development, introduced by imperial and colonial structures and now exacerbated by climate change. Indigenous communities have been identified with these ecosystems by policy makers and scientists for two broad reasons: their unique and intrinsically valued cultures (United Nations, 2009), and the insights from Indigenous Knowledges (IK) that are increasingly seen as filling gaps in the management of, among other things, hazards and risks (United Nations Convention on Biological Diversity, 2018). In this paper, we draw on interviews with Māori researchers, elders, and community representatives to discuss how mātauranga Māori (Māori knowledge; the IK of Māori) about forest and their ecosystems can complement the management of the hazards of wildfire and biodiversity loss and contribute to disaster risk reduction (DRR) strategies in New Zealand.

Wildfire is now a significant hazard to many societies, in some areas the most significant (Meng et al., 2015), and particularly for those communities that live in close proximity to forests and/or rely on these resources for income, resources, and cultural identity. As news reports on the 2019–2020 Australian wildfires began to appear worldwide, Aboriginal and Torres Strait Islanders cultural burning practices began to be cited by mainstream news

(see, for example, Kuz, 2020). Cultural burning is a set of fire management tools used by Indigenous Peoples for a number of purposes including pest management and ease of access and amenity, an array of traditional techniques to "enhance the health of land and its people" (Drake, 2020, p. 47). At the same time, a new concern was the number of animals killed by these fires; figures of over one billion animals were touted (United Nations Environment Programme, 2020). The survival of unique Australian species was threatened, and important ecosystems dangerously reduced in size and viability; the IK of First Australians is seen as providing solutions to prevent or mitigate future disasters.

However, First Australians and other Indigenous Peoples are constantly responding to multiple and overlapping disasters and emergencies that undermine their efforts to reduce disaster risks (Lambert, 2014b). This is despite the Sendai Framework and its paradigm shift in DRR, from earlier strategies of *managing* disasters once they occurred

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to *minimizing* the risk of disasters and building societal resilience to future events. Supported by 187 member states (including New Zealand), the Sendai Framework acknowledges IK as complementing and contributing to more effective DRR (United Nations Office for Disaster Risk Reduction, 2015):

> Section 24 (i): To ensure the use of traditional, indigenous and local knowledge and practices, as appropriate, to complement scientific knowledge in disaster risk assessment and the development and implementation of policies, strategies, plans, and programs of specific sectors, with a cross-sectoral approach, which should be tailored to localities and to the context;
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> Section 36 (a) (v): Indigenous peoples, through their experience and traditional knowledge, provide an important contribution to the development and implementation of plans and mechanisms, including for early warning.

The New Zealand DRR strategy, launched April 2019, notes a role for IK in its inclusion of Māori concepts and institutions, using the term whakaoranga, "the rescue, recovery and restoration of sustainable wellbeing" (Ministry of Civil Defence & Emergency Management, 2019, p. 21). This process is to be underpinned by Māori cultural values and informed by mātauranga Māori. But the integration of IK such as mātauranga Māori into DRR and other science programmes to build the now ubiquitous outcome of resilience "invites a fundamental question that must be continually revisited" (Bohensky & Maru, 2011, p. 11): whose resilience is being increased? How is mātauranga Māori "complementing and contributing" to better DRR, as called for in the Sendai Framework?

Social and ecological resilience are linked, although exactly how is poorly understood (Adger, 2000). Indigenous scholarship highlights the decline in wellbeing of Indigenous communities as they experienced the loss of keystone species, the eradication of traditional food and fibre sources, in favour of colonial land-use patterns, and the decline of surrounding and supporting ecosystems (Brännlund & Axelsson, 2011; Daschuk, 2013; Dunbar-Ortiz, 2014; Whyte, 2018). These biodiversity losses were disastrous, and many if not most Indigenous Peoples have yet to recover from this ecocide. Reducing the risk of disasters, as called for by the Sendai Framework and reiterated by New Zealand's DRR strategy, requires empirical observations on localized vulnerabilities, attuned to local-sourced solutions. We interpret this as *watchfulness*, and while it does not exclude data gathered by remote sensing, in many regions around the world it will be Indigenous knowledge holders and their communities who are *in situ* eyewitnesses to locally specific disaster risks that impact forest such as wildfires and pest and disease incursions.

As the UN has reiterated in the Declaration on the Rights of Indigenous Peoples (United Nations, 2007) Indigenous Peoples have the right to protect their IK. These knowledges are more than just *content*. Ataria et al. (2018, p. 2) point out that mātauranga Māori is "linked to Māori identity and [is] a unique part of the identity of all New Zealand citizens." It

is the body of concepts and practices brought by Polynesian settlers to Aotearoa New Zealand, inclusive of "values and attitudes . . . [and] knowledge thought to be lost and now currently under recovery." The knowledge held by Indigenous communities exists only in relationship with processes, places and people (Agrawal, 2002; Berkes et al., 2000; Sillitoe, 1998): one-size-fits-all assumptions are incorrect. As with all IK, Māori knowledges exist with a past, a present and a future, and these knowledges continue to be used and adapted to suit contemporary challenges, and are continuosly incorporated into people's lives.

While IK may have a role in addressing DRR, such knowledge continues to be at risk of misappropriation through the structural racism of colonial legacies; Māori researchers themselves are at risk (Kidman & Chu, 2019; Naepi et al., 2020). Indigenous data sovereignty has become another platform on which Indigenous Peoples demand change (Kukutai & Taylor, 2016). To reduce these complexities of Indigenous interests in DRR, we focus on Māori forest practices and practitoners to unpack how IK might complement and contribute to disaster risk reduction.

Methodology

In this article we first briefly review IK on forest, fire and biological heritage. This literature frames our interviews and workshops where kaumātua (elders), community members and Māori postgraduates and researchers were recorded discussing knowledge, research, collaboration, science, emergency and disasters. Transcribed interviews were uploaded into NVivo (Version 12) (QSR International, 2014) and key themes identified and coded. Our participants were involved in many local and national organizations, including the Environment Court, Regional Councils, marae (traditional Māori community spaces), school committees, and tribal Trusts; some also participated in international networks. All were taking part in increasingly urgent decision-making where maintaining ethical and empowered space for IK is difficult during ongoing and overlapping emergencies that increasingly include wildfire and biosecurity events (Lambert et al., 2018). All participants have roles in which their observations, their watchfulness, are fundamental to the continued development and relevance of, in this case, mātauranga Māori.

Traditional Indigenous management of forests and biodiversity

Colonization saw Indigenous Peoples dispossessed from their territories and resources, a history often framed in terms of disaster. For Māori, colonial legislation systematically stripped away control of the environment (J. Hayward, 2003; Orange, 1987), including the 1874 and 1885 Forests Acts which were motivated in part by public— that is, non-Māori—concern for "the great conflagrations of timber-bearing forests" (McLintock, 1966, para. 2.). Other legislation denied Māori access to resources and facilitated the introduction of new species, some of which

became significant pests (Grey, 1994). Choosing and prioritizing disaster risks (Tierney, 2014) or pests (Lambert & Mark-Shadbolt, 2021) are deeply political and cultural acts. Rather than gloss over all the implications of New Zealand settler colonialism (see Tawhai & Grey-Sharp, 2013 for exemplary analyses) we simply draw attention to the structural racism of colonial approaches to risks and hazards while as Indigenous communities are denied many basic needs.

The evidence for ancient and effective Indigenous fire management is now extensive (Pyne, 2012), as is evidence of the systematic removal of Indigenous Peoples and oppression of their environmental practices (Purdy, 2020). Cultural burning is the deliberate lighting of low-intensity fires to reduce fuel loads, thus preventing high-intensity fires, and often giving other benefits such as encouraging new plant growth and drawing in prey species (Bowman et al., 2011). Colonial era legislation, political marginalization, and ongoing jurisdiction issues have undermined cultural burning (Zahara, 2020). Too often, the watchfulness of Indigenous communities is so constrained as to mean they can only predict and watch disasters unfold.

Proof for similar fire practices by Māori is less clear but has strengthened. Cumberland (1962) argued for the deliberate use of fire in hunting moa, and Perry et al. (2012) found that prior to the arrival of Māori, forest fires were rare (see also Ogden et al., 1998). Williams (2009) reviews an extensive literature that records traditional fire management in horticulture including warming soils, clearing vegetation, providing nutrients. Maxwell et al. (2016) present evidence that Moriori (Indigenous People of the Chatham Islands) were actively managing their forests for food, medicines, building materials, encouraging fast growing successional species for fuel, as well as protecting some trees for protection against wind damage. Stone and Langer (2015) review the historical knowledge on Māori fire use, augmented by oral histories from three kaūmatua One of their participating kaūmatua mentioned buring undergrowth to facilitate moving through the bush, quite a common use in other parts of the world (see Stewart, 2002, for North American examples). The literature they found recorded a range of uses of fire, in addition to cooking and heating and ceremonies.

The narratives recorded by Stone and Langer present the quotidian nature of fire, it's lighting and care, and also awareness of the hazardous nature of uncotrolled fire. Modern fire regimes have seen an increase in the frequency of wildfires in New Zealand (Anderson et al., 2008), and Watt et al. (2019) argue this risk will increase by over 70 per cent in 2040, and over 80 per cent by 2090. Tepley et al. (2016) found the high flammability of vegetation that develops after fire—scrubby mānuka (*Leptospermum scoparium*) and kānuka (*Kunzea ericoides*)—and the long time needed for forest recovery were key to determining which regions may be near a tipping point from relatively minor changes in land-use or climate change. Wildfire is a hazard with increasing risks to Māori cultural and economic interests.

New Zealand's forests are an important resource but also a foundation of Māori identity (Waitangi Tribunal, 2011). In the words of a participant (Māori research, male, 56), "In many respects, our culture, our thinking, our language, our customs are derived from our natural environment. Who we are as a people is [in] some ways reflective of our local environment." Early anthropologists were often astounded at the detailed knowledges of species, ecosystem functioning, and indicators often referred to as Traditional Ecological Knowledge (TEK). Houde (2007, p. 4) argued that "the most understood aspect" of this knowledge was "the body of factual, specific observations that TEK holders are capable of generating."

While wildfire is a growing risk to New Zealand's forests, Māori also have concern at the risks from pests and diseases, highlighted by two recent threats to biodiversity. Kauri (*Agathis australis*) Dieback, caused by a *Phytophthora*, is spreading through remnant Kauri forests of these culturally significant species. IK was integrated in several programmes (Chetham & Shortland, 2013) and a rahui (Māori traditional ban or quarantine) promoted to quarantine disease-free stands. Myrtle Rust, wind-borne and prevalent throughout the world, threatens several plant species of cultural and economic value to Māori such as pōhutukawa (*Metrosideros kermadecensis*) and Mānuka. Again, communities collaborated in a policy-driven, science-informed programme (Lambert et al., 2018), ultimately formalized as the Māori Biosecurity Network/Te Tira Whakamātaki (The Watchful Ones) (Te Tira Whakamataki, 2018). The incursion of Myrtle Rust and the loss of kauri have been framed as disasters, requiring urgent responses and the engagement of community members as "eyes on the ground" (Mark-Shadbolt, 2017, n.p.). This is not to limit Indigenous participation as mere conduits of data, Māori participation has led to concrete policy changes, resourcing and capacity building for communities, and informed voices in ongoing debates about the prevention or mitigation of future fires and biosecurity events. As climate change, economic crises and ongoing unsustainable development exacerbate the risks of disaster (IPCC, 2021), including impacts on forest health, watchfulness has never been more important.

Disaster risk reduction and the role for Indigenous knowledge

The integration of IK into the Sendai Framework is an acknowledgement of the ancient wisdom Indigenous Peoples accumulate and refine through intergenerational transfer of community observations of local hazards (Lambert & Scott, 2019). Colonial interpretations of *hazard*, *risk*, *emergency*, and *disaster* expose structural racism and ongoing oppression: colonization can be interpreted as disaster risk *creation*:

> One of the greatest disasters, I think, is being Indigenous people in a society that is not based in Indigenous values. So, it's almost like we exist as being's clinging to an extinct identity in a world that does not support it to flourish. That then filters down to influence many of the other ways that we know and recognize disaster. And one of the main things that we fight at home in terms of trying to survive, is trying to keep

our identity. And that identity is largely linked to natural resources. (Female, 47)

Colonization and the associated alienation of Māori and other Indigenous Peoples from their lands, waters, resources and cultures is not only a disaster but sets up ongoing disasters. This can be seen in the threat from climate change to New Zealand ecosystems and on Māori cultural and economic resources, although as King et al. (2010) point out, these impacts will vary across tribes and communities. The 2017 Port Hills fire, a peri-urban fire in Canterbury, was a significant event in a province still recovering from the devastating earthquakes of 2011. Although only one life was lost—a helicopter pilot—several homes were destroyed and many people evacuated. The costs to the regional council and fire service were NZ $7.9 million (M. Hayward, 2017). Ngāi Tahu, the local Māori tribe, deployed their own systems of support while also cooperating with official government agencies (Radio New Zealand, 2017). This role in response and recovery echoes the Māori response to the 2011 earthquake (Lambert, 2014a; Yumagulova et al., 2021): Māori cultural institutions and practices remain valid in disaster response and recovery.

While Indigenous fire and biodiversity approaches increasingly coincide with Western science in community and societal DRR strategies, the experiences of Indigenous Peoples have been the inappropriate use of their IK and the slow and difficult development and implementation of effective policies. What does it mean for IK to *complement* and *contribute* to DRR? In asking "whose resilience is increased?," we looked for echoes, parallels and insights of DRR from the experiences of our participants in their use and understanding of mātauranga Māori.

Results

Over the course of several projects, kaumātua, researchers, and community members were interviewed—separately and in recorded workshops—on fire and biosecurity issues in New Zealand (Ataria et al., 2018; Ataria & Mark-Shadbolt, 2015; Mark-Shadbolt et al., 2018; Scott, 2019). We have organized selected quotes into several categories to better show how mātauranga Māori frames how kaumātua and community members understand their roles in protecting forests and forest biodiversity.

Mātauranga Māori

First, the breadth, relevance, and validity of IK is a constant challenge from discipline-framed research and researchers. One participant summarized mātauranga Māori as:

> . . . a term that probably came through in the late 19th century to differentiate the Māori worldview from non-Māori. And what's happened is that term now is embracing a wide range of knowledge forms, rather than just the "traditional." It's actually starting to embrace all those. (Male, 56)

He went on to argue that Māori knowledge holders accept and adapt to multiple knowledge systems:

> So even though we might talk about traditional knowledge in one sense, when we actually use the term mātauranga Māori we're actually talking about a continuum of knowledge forms right through to that fusion with more contemporary Western knowledge. It's really still a Māori led or Indigenous way of thinking about a problem or an issue. (Male, 51)

This ability of Indigenous knowledge holders to be remarkably adept at intellectual diversity was echoed by another participant:

> Māori experts have been experts at picking the best things out of both cultures: technology is a case in point. They are happy to use something if it makes the job or the process go more smoothly. And it's almost as if religion was seen in that same light, as there were some really good aspects that Māori liked and took it and used it and still use it today, but still are absolutely comfortable moving into the more traditional space when and where that's needed and required, and only they will know best when to do that. But it just seemed they could just, without flicking an eyelid, just move seamlessly between the two. (Māori research, male, 51)

Other studies have also shown this intellectual promiscuity and pragmatism among Indigenous thinkers. Battiste and Henderson (2009, p. 5) argue that IK are trans-systemic,

> [a] part of the collective genius of humanity of Indigenous Peoples that exists in the context of their learning and knowing from the places where they have lived, hunted, explored, migrated, farmed, raised families, built communities, and survived for centuries despite sustained attacks on the peoples, their languages, and culture.

Mātauranga Maori and other IK do not fit easily within academic *disciplines*. We see that our experts are members of loose *communities of practice* in which various knowledges are available. We thank an anonymous reviewer for this insight.

The grounded and active nature of IK was expressed by a kuia (old woman) in discussion with a Māori researcher:

Kuia:	It's not to say that your opinion is wrong, but yours is just another opinion. But how sincere is that opinion of yours if you have never lived it?
Māori Researcher:	So maybe that was why there's been no [Māori] word for knowledge, because it's such a personal thing. Everyone has their own experience.
Māori Researcher:	There is no generic word. So, I was just thinking, in Māori, "Ko mārama koe?" Ko mōhio koe?"; it's more of an action, rather than a noun word: "Do you understand this knowledge?"

Here, we see the power and dynamism of IK as a living *database* and not a static set of facts. Likewise, all participants appreciated the importance of intellectual property which is often explicitly claimed by a research institutions via research agreements. Indigenous Peoples have challenged Western assumptions of ownership and control with experiences of theft and inhumane display of Indigenous bodies, living and dead (Aranui, 2018). But parallels within our community of practice of the academic interest in attribution and citation was echoed by a Māori researcher:

> Māori have huge value on knowledge and that needs to be communicated, that needs to be understood. Often knowledge is used, people are given knowledge and they take that knowledge for themselves. There's a whole understanding around the need to acknowledge where that knowledge comes from. Again, that's something that's actually not dissimilar from Western science. It's very important to acknowledge where you get information from. (Male, 53)

Fire hazard

While Māori are now predominantly urban (over 85%), rural districts still contain significant Māori communities on traditional territories, maintaining repositories of cultural assets, and with intergenerational relationships with a biological heritage. As climate change leads to hotter and drier conditions, iwi (tribe) and hapū (sub-tribe) authorities must prepare for more urgent events as well as the long-term climate change. The Port Hills Fire destroyed conservation areas valued by local iwi with the loss of cultural and ecological values. Māori also have significant economic interests in biodiversity including forestry and farming ventures (Nana et al., 2011). Regarding risks to these resources, one participant noted,

> When you talk of "risk" and "hazard," I don't think we actually have Māori words for those terms. So, it's got me thinking, well, what is the context? What is the language that we use to describe those types of things? And I guess what comes to mind when you talk about risk, risk reduction, are some basic values that I think that Māori have, like manaakitanga which is the notion of the responsibility for caring for things, both animate and inanimate things . . . kaitiakitanga, stewardship of natural resources and the notion of creating benefit and wellbeing for your community, for your people. (Male, 53)

In these comments, we see the dynamism of how IK interprets new realities as mātauranga Māori provided an intellectual grounding for interpreting risk and risk reduction. Unfortunately, many participants were experiencing the decline of mtauranga. In many rural Māori communities, the use of fire to dispose of waste has long been a practice; for some households, it is a cheaper and easier method of disposal than transporting waste to facilities which charge for disposal (Langer & McGee, 2017). An interesting quote from one of our focus groups gives an Elder's childhood experience:

> Our parents taught us how to be fire safe. They taught us a lot of tikanga and safety, how to cook on an open fire . . . how to light the open fire . . . you only put so much wood under, and the embers had to be way back. There was a whole safety approach. How to be safe with fire. Today, we don't do that to our children because today it is totally different, it's all switches and buttons. (Kaumātua, female, 70s)

While older participants grew up with fire, many traditional practices were discontinued and the mātauranga about fire risks was much reduced. As far as identifying and reducing risks, another of our participants noted a lack of leadership in risk management:

> One of the things that the iwi specified, in terms of its leadership, is that you must be located in the community. Now that's fine if you're located in Christchurch or Wellington, where you have a pool of each kind of people. But if you're at home out on____, you're not going to have those types of people who are used to working in those types of processes or institutions, or can even communicate like that. The ability to assess . . . and respond [to] the needs of your people, to keep them safe, is quite limited. (Female, 47)

It is not simply that DRR needs Indigenous knowledge holders, but also Indigenous knowledge holders who can mobilize their IK for the purposes of policy, legislation, and regulation.

Intergenerational transmission of IK

The transmission of knowledge to a succeeding generation was an issue that concerned kaumātua:

> How do we transfer that [knowledge] to the next generation? We touched on it again this morning, looking at maybe this is about three different levels at this stage. We have our rangatahi [young people], like these ones here that are in ngā whare wānanga [houses of learning]. Then we have our own tamariki [children] and mokopuna [grand children] that have been raised in the cities and then we have our tamariki and mokopuna that have been raised offshore. (Male, 60s)

Two kaumātua, describing the traditional practices of mentoring people into roles, recalled that Māori would observe their own children and young people:

> Transfer[ing] that mātauranga and that information to them by watching them grow up amidst us on the marae. Then we would get a good insight into just what is the skills that that child has, where would she strategically be placed to be utilised . . . to serve their people. (Male, 60s)

Ongoing migration to urban areas was seen by this kaumātua as disrupting this intergenerational transfer of IK:

> Now we have a lot of our children living in the cities, and offshore. That [traditional] process is not as strong as what it used to be, because a lot of them are living away. And now. . . a lot of us are having to share with maybe other youth from

other iwi. Maybe not the in-depth detail, but about certain things, about the way we work in certain areas . . . looking for ways on how we engage them now. (Male, 60s)

Empirical observations as watchfulness

Key themes restated throughout all interviews and wānanga were the difficulties in being heard, understood, and seeing positive change. An Elder was asked his thoughts on the role of forests in supporting his wellbeing:

> Well, you didn't visibly see it, you felt it. It was mauri [life force]. It's visible by smell, and by feel . . . Feel the wind blowing in your face, and feel sometimes water dripping down off the trees onto you, feeling good, feeling healthy, the fresh air, hearing water trickling down in the stream as you're getting close to it, or seeing the spray spewing over the waters and that. It's all those things that make up that health. . . . I call it the mauri. Mauri is something that is not that easy to describe. I've seen it translated as life force, but it's not just that. It's a hell of a lot more than that, and I think I've tried to describe it in a whole lot of [ways]. It's all the things that the senses feel, and the body feels. It's physical. You can feel it physically, you can feel it mentally, you can feel it spiritually. (Male, 70s)

The health of forests was important to the same Elder who was asked about the current biosecurity management of Kauri Dieback: "Is it working, is it not working?"

> Of course it's not working! We're doing all these management things, and it's not making any difference. It's still spreading. To me, if these things were working, it would be confined to where you've already found it. So obviously, they're not working.

It is not just identifying hazards but closely observing them with insight and understanding of the wider contexts –including a temporal continuum of long past and distant future– and being empowered to act on these understandings. As one participant said about their collaboration in biodiversity management:

> Based on all those different knowledges . . . the ecosystems plan should be different in every region. Because you know the different ecosystems there . . . we test something, we try it. And we observe it and document it. Just the same as [scientists] would, but it's our solution. (Female, 39)

One Elder, commenting on the government's biosecurity responses to Kauri Dieback, was adamant in the efficacy of *karakia* (prayer):

> I've said a number of times that I've just prayed, karakia, that myrtle rust stays out of our rohe [district]. You can look, none of these are dying from myrtle rust, I'm pretty sure. And I still believe that that's . . . what's keeping it out. We still haven't found any within our rohe. (Male, 70s)

Removing the sacredness of these ecosystems leaves what one participant called maroke or dry and arid relationships, where nature is interpreted as *services*, a passive subject instead of, in the words of our participant, "this connectivity around wairua [spirit] and balance" (male, 53).

Our participants are continuing their collaboration in this programme that now includes the kaumātua being supported in designing and implementing their own research programme. What follows is a discussion on how we interpret our results in the light of wider DRR discussions that seek to engage with IK and IK holders and practitioners.

Discussion

Disasters and emergencies provide a powerful lens to analyse society and its understanding and use of knowledges. What has become apparent to some non-Indigenous DRR experts is that IK provide insight in addressing disaster risks, and may even be decisive in some pressing concerns such as wildfire mitigation and biodiversity protection. Our participants challenge assumptions that resilience is universally and evenly improved through strategies of engagement between Indigenous Peoples and non-Indigenous societies. Success in complementing and contributing from an Indigenous perspective will always be contingent on local settings. The kaumātua, researchers and community members we spoke to emphasize that mātauranga Māori is place specific, collectively owned and claimed, and action-oriented. Kaumātua we spoke with were extremely careful about their claims to *know* something, always referencing their source and basing their understanding primarily on personal experience, that is data gathered by their own eyes and ears. Attribution is as important for Indigenous knowledge as it is for academic citation indices. While they also defaulted to oral transmission, the words spoken to us only represent a small fraction of what they know. Indigenous rights and the sovereignty of Indigenous Peoples must be integrated into data management if their *contributions* to DRR are to be treated equitably, ethically, professionally, and—dare we say—productively.

While having confidence in their knowledge, and often excited by the prospects of collaboration with science, participants expressed frustration at the lack of opportunity, respect or power at local, regional, and global scales in framing and implementing DRR strategies that are effective for their communities. Drawing out insights for effective DRR requires the creation and maintenance of culturally safe and empowered spaces for Indigenous *contributions*. An extension of this safety and empowerment is needed in response to the increasing sophistication and reach of data gathering. Remote-sensing technologies, satellite imagery, electronic surveillance, and massively improved computing power are behind many state and private operations, including environmental management, that threaten Indigenous citizens (Lambert & Henry, 2020). These technologies of distanced digital *watchfulness* outpace the ability of societies to understand and control. Our participants recognized science and technology communities as important to the risk management issues they faced. But the cultural lens remains, indeed is perhaps more refined and polished through the experiences of collaboration; however, poor those experiences was.

Urbanization, mentioned by one kaumātua regretful at losing young tribal members to the allure of city life,

complicates Indigenous lives including the risks they face. While the Port Hills fire might be a wake up call for New Zealanders, as were the Christchurch earthquakes, the 2019 mosque shootings by a white supremacist and now the Covid 19 pandemic, the reality is these events sit within a trajectory of history that has also provided the tools and mechanisms to prepare, reduce, respond, and recover from such events. Yet, such tools are not universally available, and the speed at which decisions must be taken—or framed as they must be taken by some participants—challenges all knowledges.

Indigenous DRR began with tradition, has endured imperial and colonial oppression, and is now responding to equally harsh neoliberal forces (Bargh, 2007) that continue to embed disaster risk creation. Matthewman (2015, p. 169) argues that in many instances "[t]he disaster has already happened"; society has structured disaster into *development* and all we can do is to "work our way out if it." And so risks to New Zealand's biodiversity from ongoing biosecurity events and more frequent and larger wildfires increase, despite ongoing political rhetoric and growing research dollars (National Science Challenge Biological Heritage, 2019). Yet Indigenous voices continue to nimbly articulate the hazards, risks, and disasters they face. Ironically, these voices may find wider acceptance as disasters increase in scale, intensity, and impact.

During the course of this research it became clear that the focus on IK, carried by key informants (primarily elders and community environmental guardians) was somewhat misguided. Rather, it was the knowledge holders and practitioners embodying these knowledges in a physical presence on the land and in the forests that were the means by which their mātauranga would complement and contribute to wider strategic aims. Their presence in the forests needed to be transferred more than translated for decision-making in strategic approaches to mitigating damage and minimizing future hazards, in other words DRR:

> How do [we] ensure the wellbeing of the knowledge? Which in itself acknowledges 'How to ensure the wellbeing of the knowledge holders'? (Female, 30s)

This is not to dismiss the potential of IK to complement and contribute to DRR as called for in the Sendai Framework. Rather, we acknowledge the contingency of empowered engagement. One interesting outcome of these discussions was the evolution of a project out of concerns for elder wellbeing. We argue that while their knowledge is obviously important, it is the lived experience of knowledge holders and practitioners within expanding—and perhaps sometimes contracting—but always porous communities of practice that provide a mandate to watch over specific forests and ecosystems. Their watchfulness built on past rights and sovereignty must be combined with modern acknowledgement of rights and necessary empowerment to then inform policy, regulatory, and legislative contexts. Only then will the aspirational Sendai Framework goals lead to more effective strategies off DRR for Indigenous Peoples.

Conclusion

IK on forest and biodiversity management have had a resurgence within disaster risk reduction discourse as increasing and overlapping disasters reveal knowledge gaps in reducing the risks to forests and their biological heritage from fires, pests and diseases. Such knowledges are now seen by policy makers, scientists, and various non-Indigenous communities as insightful and valuable in providing scale-dependent, often location-specific, information on more effective disaster risk reduction. While the Sendai Framework provides the most explicit acceptance of IK, and sees these knowledges as providing collaborative synergies, the validity of IK can exist only within Indigenous defined parameters, delineated, and patrolled—to greater or lesser extent, and not without internal challenges—by their own holders and practitioners. Importantly, we find the physical presence of knowledge holders and practitioners on the ground—their *watchfulness*—is fundamental to how IK continues to inform disaster risk reduction.

Indigenous communities will interpret their vulnerabilities as risks *to their cultures* in addition to their physical, financial, and social wellbeings. The experts these communities have trained and defer to are adept at holding and using diverse approaches to understanding the world around them. Indigenous communities play by similar rules as science communities, valuing expertise and experience, being firmly transparent on attribution, wanting to secure and protect data, and wanting to disseminate and teach. For IK to truly complement and contribute to disaster risk reduction, Indigenous rights and cultural values must first be acknowledged and then actively supported by those who wish to understand, and benefit from them. Knowledge holders and practitioners must be safe to move through their forests, and over their lands and waters. Acknowledgement of IK in DRR at UN, regional and national levels must now move beyond rhetoric and be matched by resources, official support, empowered engagement, safe opportunities, and appropriate action at community levels.

Glossary

hapū	sub-tribe
iwi	tribe
kaitiakitanga	stewardship of natural resources; environmental guardianship
kānuka	*Kunzea ericoides*
karakia	prayer
kaumātua	elders
Kauri	*Agathis australis*
Kuia	old woman, grandmother
Kumara	sweet potato
mānuka	*Leptospermum scoparium*
mātauranga Māori	Māori knowledge; the IK of Māori
marae	traditional Māori community spaces
maroke	dry, arid
mauri	life force; all the things the senses feel; physical, mental and spiritual feelings
mokopuna	grandchildren
Moriori	Indigenous People of the Chatham Islands

ngā whare wānanga	houses of learning; usually a tertiary education institution or university
Ngāi Tahu	predominant Māori tribe, South Island, New Zealand
pōhutukawa	*Metrosideros kermadecensis*
rāhui	Māori traditional ban or quarantine
rangatahi	young people
rohe	district
tamariki	children
Te Tira Whakamātaki	The Watchful Ones; the Māori Biosecurity Network
tikanga	appropriate practices
whakaoranga	recovery, restoration

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