



A critical review of the inclusion of mātauranga Māori in published environmental research

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Abstract: Globally there has been a burgeoning consensus that drawing from Indigenous knowledge in environmental management improves outcomes. Over the past two decades, in Aotearoa | New Zealand there has been increased interest from Western-trained researchers in mātauranga Māori (Māori knowledge). In response to this growth in scholarship, this review explores journal articles at the interface of mātauranga and environmental research, characterises the growing body of scholarship, and evaluates ongoing challenges and opportunities. We used both the Web of Science and Google Scholar to identify 81 peer-reviewed articles and traced patterns of research across themes of understanding species, place-based research, monitoring and management, kōrero tuku iho and connecting Indigenous knowledge systems. The prevalence of papers in the understanding species theme highlighted the importance of mātauranga Māori in deepening knowledge of specific species. Papers that connected to our place-based research theme focused on a specific environment in a particular location. These papers typically had very strong connections to iwi (tribes) and hapū (subtribes). Most of these papers stood out as very powerful examples of using both mātauranga and dominant science to understand and, in many cases, improve the environment. Papers in the kōrero tuku iho theme draw from oral traditions and historic views of Māori with respect to the natural environment. Connecting with other Indigenous knowledge systems reminds us that our systems of knowledge can be connected, despite geographical differences, as they are born from a close physical, cultural, and spiritual relationship with the environment. The management and monitoring theme was the most prominent, comprising 41% of the total papers reviewed. This is unsurprising given the significance of te taiao to Māori and the unique space for mātauranga Māori that has been created through policy and law in Aotearoa. The cumulative number of papers connecting to mātauranga Māori in environmental research has increased over time from one in 2004 to 81 in 2022, and 21% of these were published in special issues between 2018 and 2020 focusing on mātauranga Māori in New Zealand journals. These articles illustrate a shift in the research landscape, moving from tokenistic engagement with Māori to creating space for rangatiratanga (sovereignty) in research. There have been some changes in power dynamics, with a move from the native informant role to recognising the expertise of mātauranga Māori practitioners in co-authorship positions. The present review hopes to contribute to understanding where we have been to determine collective flourishing futures for mātauranga Māori and environmental research in Aotearoa.

Keywords: Indigenous knowledge, Māori, mātauranga, science, taiao

Introduction

Globally, the need to incorporate Indigenous knowledge in environmental management is becoming more obvious, accepted, and urgent (Thompson et al. 2020). UNESCO (2024) has acknowledged the need for and value of drawing on knowledge from multiple sources. Indigenous knowledge has informed and influenced environmental management for

generations, enabling sustainable management of the land and its biodiversity for, in some cases, thousands of years (Marsden 2003; Thompson et al. 2020; Hernandez 2022). In Aotearoa¹,

¹New Zealand and Aotearoa are used throughout this paper. New Zealand is used when referring to colonial structures and ideas. For example, we use New Zealand when referring to our current research system as it is an inherently colonial system.

Māori have used mātauranga to live and thrive for at least 700 years. This knowledge was and is acquired by interacting with the environment, defined by our whakapapa (genealogy) that links us to the whenua and determines our kaitiaki obligations.

Although mātauranga is commonly defined as Māori knowledge, it encompasses much more than simply knowledge itself (Hikuroa 2017; Mead 2025). It is the pursuit and application of understanding through a systematic methodology that incorporates Māori culture, values, and worldview. Mātauranga has been described as the ūkaipō (source or origin) of knowledge in Aotearoa (Hikuroa 2017). By spanning Māori culture, values, and worldview, and combining techniques consistent with scientific methods, mātauranga produces practical, emplaced knowledge. Mātauranga exists in pūrākau (stories), waiata (songs), whakairo (carvings), tikanga (customs), and te reo Māori (the Māori language). It is a distinct knowledge system built upon a Māori worldview and epistemologies. Mātauranga is an experiential system that emphasises place- and relationship-based learning, using whānau (family) and hapū (sub-tribe) understandings of our taiao (the environment; Broughton & McBreen 2015). Rather than being a static catalogue of ancestral knowledge, mātauranga is constantly growing and expanding through exploration, understanding, and theorising at the whānau, hapū, and iwi (tribe) levels.

The term mātauranga has become a catch-all phrase, but it usually refers to mātauranga-ā-hapū and mātauranga-ā-whānau; that is, mātauranga exists at the local level. At the time of Pākehā (European settlers) arrival in Aotearoa, Māori had been developing mātauranga-ā-hapū and mātauranga-ā-whānau for at least six hundred years, building on the foundations of their Polynesian ancestors. In pre-colonial Aotearoa, mātauranga-ā-hapū was flourishing, with knowledge being passed down orally through methods such as whare wānanga (traditional schools of learning; Mead 2025).

In this review, we use the term science to refer to “the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence” (Science Council 2015) derived from both Māori and Western contexts. We use Western science or dominant science to denote the currently dominant knowledge system and to highlight the historical movements and philosophies that remain embedded within it today (Liboiron 2021). While Western science does incorporate knowledge from non-Western epistemologies, such as the symbolic languages and the 12 hour clock obtained from the Sumerians, the Hindu-Arabic decimal numeric system, and modern engineering based on Roman knowledge (Cole 2017), its structures—including hierarchies of knowledge, the exclusion and inclusion of certain forms of knowledge, and the compartmentalisation of disciplines—reflect Western philosophical traditions (Broughton & McBreen 2015).

Disruption of Indigenous scholarship and relationships to taiao

The arrival of Europeans in the late 18th century and following colonisation had, and continues to have, devastating effects on not only Māori people but on Māori knowledge. Early Pākehā settlers welcomed the declining populations of Māori, with one medical scientist proclaiming that Māori were “dying out in a quick, easy way, and are being supplanted by a superior race” (Newman 1881, p. 477). When they realised they could not “smooth our dying pillow,” (quoted in Hiroa 1924, p. 362), Pākehā sought to assimilate Māori through various policies

and practices enabled by the colonial government (Hunn 1960; Walker 1990). These policies functioned to destroy Māori culture, values, and knowledge. Colonisation involved the theft of significant swathes of Māori land (O’Malley 2019), severing hapū and whānau connections between whenua (land) and whenua (placenta) (Moewaka-Barnes & McCreanor 2019). The introduction of a foreign economy further pushed Māori to move into urban centres, disrupting the intergenerational transmission of knowledge (Williams 2019).

Two examples of policies that functioned to subjugate Māori culture and mātauranga were the Tohunga Suppression Act 1907 and the Native Schools Act 1867. The latter aimed to assimilate Māori into Pākehā society through education, resulting in English being the only language permitted to be written or spoken. As a result, Te Reo Māori was literally beaten out of a generation of Māori. Native schools aimed to eliminate Māori culture from the curriculum (Walker 2016), which had devastating consequences for mātauranga. Similarly, the Tohunga Suppression Act represented an attempt by the New Zealand government to suppress traditional Māori knowledge (Voyce 1989). It aimed to replace tohunga (traditional Māori healers and holders of deep knowledge) with Western medicine and assert political dominance (Stephens 2001). More recent moves to elevate the status of mātauranga and recognise its value in research arguably represent a step in the right direction and could be viewed as an attempt to right historical wrongs.

Nevertheless, the consequence of colonisation has been the relegation of mātauranga to a diminished role in New Zealand (Broughton & McBreen 2015). Simultaneously, environmental management in this country is mostly undertaken by Crown entities such as Territorial Authorities (TAs) or Ministries. Even local community groups usually work under TA guidance. Under this regime the state of the environment has noticeably deteriorated (Ministry for the Environment & Stats NZ 2022). To reverse the current deterioration of our taiao we must find a way to privilege mātauranga Māori in our environmental management, monitoring, and reporting frameworks. Mātauranga Māori is a vast knowledge system that is likely to be instrumental in preserving the environment and restoring what has been damaged.

Beginning to rebuild

As is occurring elsewhere in the world, many TAs around New Zealand, as Crown partners under Te Tiriti, are now endeavouring to build effective partnerships with mana whenua (a group of people who have territorial rights to place through whakapapa). Effective partnerships should honour Te Tiriti o Waitangi and acknowledge Māori rights to self-determination and interests in the environment (Greater Wellington Regional Council 2024). This is now becoming a statutory obligation under the National Policy Statements for Freshwater Management and Biodiversity (Ministry for the Environment 2020, 2023). As a nation, we not only have to meet our management and reporting obligations at a community level but also have reporting obligations to the OECD and are obliged to comply with the United Nations Rights of the Indigenous People (Siegfried 1999).

It is no accident then that one of the primary sites for assertion of mātauranga into research is in fields relating to the environment, facilitated by drivers both within and outside of government. Arguably, the most important of these are the Vision Mātauranga policy (VM; Ministry of Research Science & Technology 2007) and the WAI262 claim (Waitangi Tribunal

2011). The VM policy was introduced in 2005 and emerged at a time when Māori were reclaiming greater involvement and interest in research (Smith 2012). It is based on the notion that opportunities exist within Māori communities that should be harnessed through effective engagement for the benefit of New Zealand. Vision Mātauranga also aims to increase Māori capability and capacity in the research sector. Since 2010, the policy has been implemented across many facets of New Zealand's research sector and integrated into government investment areas. Most research institutions in New Zealand have addressed VM by explicitly including it in their organisational aims and, in the case of most universities, by employing Māori advisors to assist researchers with incorporating VM into their funding proposals.

Despite these efforts, the implementation and enactment of VM by organisations and individuals has been inconsistent. While there have been excellent examples of research conducted at the interface of Western science and mātauranga, its application has also been critiqued. Some argue that VM has enabled the marginalisation and commodification of mātauranga, resulting in superficial engagement with Māori (Barber 2022). The primary author of the VM policy, Te Ahukaramū Charles Royal, has noted that it has “not had the amount of activity, inspiration or spirit... initially envisioned.” (quoted in Rayne et al. 2023, p. 1034). Additionally, Ani Mikaere described the VM policy as an attempt to divorce mātauranga from rangatiratanga. She states that it “treats mātauranga as some kind of inferior subset of Pākehā knowledge, a collection of material which is nevertheless freely available to anyone seeking to appropriate it in order to ‘add value’ to Western science or to ‘contribute’ to the New Zealand economy” (Mikaere 2015, p. 10).

Meanwhile, WAI262 is arguably one of the most significant and far-reaching claims considered by the Waitangi Tribunal. The original claim, lodged in 1991, stated that, consistent with tino rangatiratanga as recognised in Article 2 of Te Tiriti o Waitangi, iwi hold all rights relating to the protection, control, conservation, management, treatment, propagation, sale, dispersal, and utilisation of Indigenous flora and fauna and the genetic resources contained within them. One of the key issues covered in the claim, relevant to this review, was the misappropriation of mātauranga through Western research processes and the need to protect Māori knowledge systems. WAI262 provides guidance on how researchers and scientists should engage with Māori knowledge and people. The Rauika Mangai guide emphasises the importance of co-designing all projects involving taonga Māori (treasure, anything prized), and developing respectful, reciprocal relationships (Potter & Rauika Māngai 2022).

The growing recognition of the importance of te ao Māori (the Māori world(view)) in scientific research has been met, at times, with knee-jerk negative reactions by some scientists who view mātauranga as “falling short” of science (Clements et al. 2021). This review seeks to add to the work of a number of Māori scholars who have pointed out the many ways that mātauranga and science add value to one another. We do not aim to debate the philosophical meanings of mātauranga Māori and science, but to discuss through our analysis how the interactions between these knowledge systems are shown in practice/praxis.

The present challenge

While it is an imperative to bring mātauranga Māori and Western science together so that we may address environmental

crises, the integrity of each distinct knowledge system must be maintained. Indeed, to give mātauranga the same authority and power that currently resides with Western science, greater emphasis must be given to mātauranga. These two cosmologies must coexist and function in a way that builds a collective wisdom or at least collective knowledge bases that can be used to improve overall environmental management effectiveness (Rauika Māngai 2020). This will involve building *tohu pūtaiao/taiao* (Māori scientific indicators) and Māori ecological outcomes into monitoring and reporting frameworks and conducting research using *Kaupapa Māori* research methods (Smith 2012). The growing number of Māori academics and scientists will become an invaluable resource to affect this change and continue the current resurgence of mātauranga Māori in Aotearoa.

The increasing numbers of Māori academics studying Western science disciplines from their own unique positionality has improved the number and effectiveness of Crown/Māori partnerships (co-governance, co-management, and co-research). The result is a growth in efforts to effectively decolonise science (Finlay-Smiths et al. 2025; Moko-Painting et al. 2023; Tadaki et al. 2022). The tangible result is a burgeoning number and improved quality of research papers utilising both mātauranga and Western science, ultimately expanding our collective knowledge corpus and leaving us better positioned to address critical environmental issues.

In response to this growth in scholarship, this review aims to explore journal articles at the interface of mātauranga and environmental research. In doing so this review characterises this growing body of scholarship and evaluates ongoing challenges and opportunities. We trace patterns of research across themes of understanding species, place-based research, monitoring and management, *kōrero tuku iho* and connecting Indigenous knowledge systems. We have undertaken this analysis through the lens of *Kaupapa Māori* research methods (Smith 2012) that center research on Māori epistemologies, histories, and worldview as a foundation for advancing research at the interface of Western science and mātauranga Māori into the next decade.

Methods

Literature reviews are components of research that enable a comprehensive understanding of existing written knowledge and identify gaps for future research (Jesson et al. 2011; Leonard et al. 2023). There is a growing global interest in Indigenous knowledge systems, and this review offers a timely contribution to understanding how mātauranga has been incorporated into environmental research. Increased interest from Western-trained researchers, driven by policies such as the VM policy, has sometimes led to superficial, tokenistic, and unethical interactions between Māori communities and researchers. Our hope is that some of the journal articles highlighted in this review provide guidance on how to meaningfully include Māori people and knowledge in research.

Our initial approach was to explore mātauranga and science; however, we encountered early challenges, as we felt framing mātauranga Māori around Western science was problematic. Mātauranga Māori does not map naturally to the boundaries of Western science disciplines making it difficult to label certain knowledge as science or not science—for example, in health spaces where traditional knowledge combines biophysical health models with societal and spiritual

frameworks. Therefore, we chose to focus on mātauranga Māori in a taiao context. This provided enough of a boundary to exclude some research areas while remaining broad enough to include many Western science disciplines. This narrower focus also allowed for meaningful themes to be identified and comparisons to be made.

In January 2023, we used both the Web of Science and Google Scholar to search combinations of the terms mātauranga Māori, science, ecology, Indigenous knowledge, Aotearoa, and New Zealand. Our analysis focused on practical and applied research, though theoretical literature was used to inform our introduction and the formation of our five themes. Key information, including details about the authors, their institutions/organisations, study locations, iwi involvement, and methodologies used, was extracted from each of the 81 articles we reviewed. For a paper to be included in the review we required that some meaningful discussion of mātauranga Māori and/or incorporation of mātauranga in research methods was included in the paper. This allowed us to exclude papers which mentioned mātauranga in a tangential manner (e.g. mentioning VM funding) but did not fully engage with te ao Māori. We determined Māori authorship by self-identification by the reviewed article's author(s) as listed within the articles themselves or as documented in other locations (publicly accessible biographies, websites, or community knowledge). Papers were reviewed and thematically analysed according to Clarke and Braun (2017). Thematic analysis is a widely-used qualitative method for identifying and analysing patterns in data, whereby a process of data familiarisation and coding is used to generating themes (Clarke & Braun 2017). Given the absence of an existing database specifically related to research at the interface of mātauranga and environmental research, we have created a database of the literature we reviewed (see Appendix S1 in Supplementary Material).

Articles in peer-reviewed journals remain the dominant shared currency of modern science and research. Therefore, we have chosen to limit the scope of this review by excluding theses, books, and reports. During our review, we encountered many brilliant masters' and PhD theses which have not been

republished as journal articles. Consequently, the present analysis will not capture all of the important work at the interface of mātauranga and science, most of which exists outside the bounds of peer-reviewed articles

Findings

The results of this review article shed light on the critical intersections between mātauranga Māori and environmental research. Through an examination of published and peer reviewed literature, the review identified five key themes: understanding species, place-based research, monitoring and management, kōrero tuku iho and connecting Indigenous knowledge systems. These results provide valuable insights into ongoing efforts to elevate mātauranga Māori within New Zealand's research sector.

We identified 81 peer-reviewed papers that explored the interface of mātauranga Māori and taiao. The cumulative number of papers published in this space has increased over time, from one in 2004 to 81 in 2022 (Fig. 1). Over the past five years, there has been a significant increase in the cumulative number of papers, which coincided with mātauranga Māori special issues in the *New Zealand Science Review* (2019, 2020), *New Zealand Journal of Ecology* (2018), and the *New Zealand Journal of Marine and Freshwater Research* (2018). The majority of papers (64%) were published in local journals rather than international journals.

Of the reviewed articles, 60% ($n = 50$) had a Māori first author, and 21% ($n = 11$) had no Māori authors. Conversely, 18% of papers had entirely Māori authorship teams. Only 16% ($n = 13$) identified as using Kaupapa Māori research methods.

Each of the 81 articles was reviewed and manually coded for the associated themes. Each paper was allocated to a single theme. The most prominent themes included management and monitoring (41%) and understanding species (22%; Fig. 2).

Place-based research

Papers that connected to our place-based theme were focused

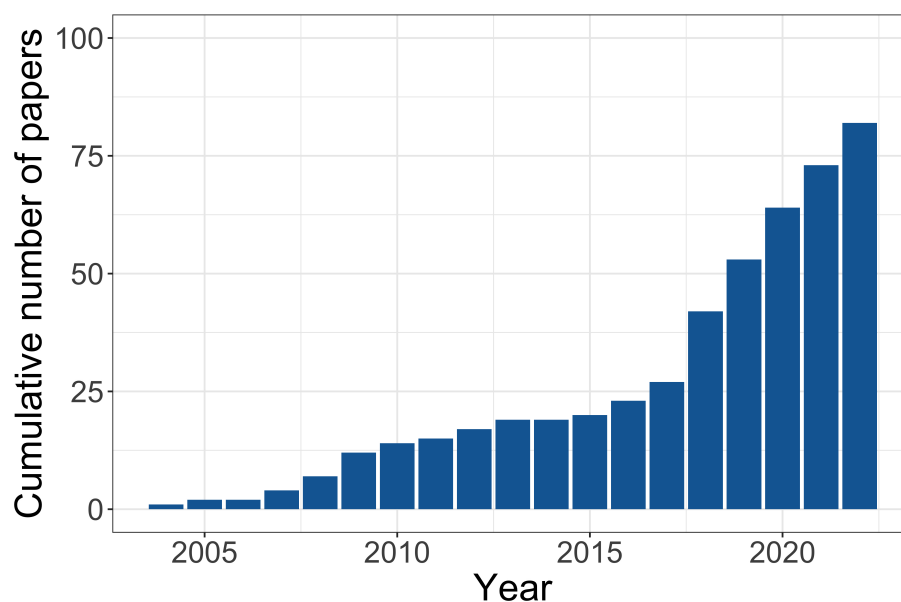


Figure 1. A bar graph showing the cumulative number of papers at the interface of mātauranga and dominant science in the taiao space published between 2004 and 2022.

on a specific environment in a specific location, whether that be an awa (river), roto (lake), or ngahere (forest). These papers typically had very strong connections to iwi and hapū. Most of these papers stood out as very powerful examples of using both mātauranga and dominant science to understand and, in many cases, improve te taiao.

All the papers about ngahere were connected to Te Urewera and all of them involved the Tūhoe Tuawhenua Trust (Lyver et al. 2008, 2009, 2017; Timoti et al. 2017). The lead or second author for all these papers was Dr Phil Lyver (Ngāti Toa Rangatira) of Manaaki Whenua. Tūhoe Tuawhenua mātauranga was centred through interviewing Tuawhenua Māori, particularly kaumātua (elders). Many papers explored the mātauranga of kererū (*Hemiphaga novaeseelandiae*), indicating its importance as a taonga species that provides insight into ecosystem functioning and degradation. These studies are excellent examples of how using both mātauranga and dominant science can enhance management and conservation of our taiao.

Six of the nine papers in this theme that were place-based, wai focused research were from a mātauranga Māori focused special issue from either the *New Zealand Journal of Ecology* (Carter 2019; Michel et al. 2019; Ratana et al. 2019) or the *New Zealand Journal of Marine and Freshwater Ecology* (Hikuroa et al. 2018; Hopkins 2018; Maxwell et al. 2018). All but two of these papers were also led by Māori researchers. These papers focus on understanding a specific body of water (including lakes, rivers, and marine environments) and most exhibit a very strong relationship and grounding in mātauranga-ā-iwi, mātauranga-a-hapū, and mātauranga-a-whānau. A common element of most of these papers is the discussion of mauri/mouri as a key guiding concept. They often focused on uplifting and enhancing the mauri of a specific body of water. Henwood and Henwood (2011), for example, focus on

understanding how Lake Ōmāpere has been degraded over time, connecting environmental issues to colonisation and land alienation. They highlight how mana whenua kaitiakitanga (guardianship, stewardship) and effective management have led to improvements to the mauri of Lake Ōmāpere. Papers connecting to this theme drew from both scientific methods (including GIS, eBeam) and mātauranga-a-hapū (including interviews and mōhiotanga tuku iho [ancestral knowledge]), in order to support iwi and hapū based decision-making and restoration of te taiao (Ratana et al. 2019). They existed on a spectrum, some leaned more heavily on science (i.e. Salmond et al. 2022), others effectively drew from mātauranga-a-hapū and science (Ratana et al. 2019), and others were based almost entirely on mātauranga (Hopkins 2018).

Although these papers focus on wai at specific sites, they were generally considered within a broader environmental context of te taiao, consistent with a Māori worldview where everything, including spiritual elements, is connected through shared whakapapa. Hopkins (2018), for example, focuses on the Matahuru awa but also explores the importance of ngāhere and manu (birds and other winged animals) in enhancing the mauri of the awa and restoring mana to the hapū. Similarly, Salmond et al. (2022) discuss ki uta ki tai (from mountains to sea) and focus on entire ecosystems, recognising how processes in awa influence and are affected by what occurs on the whenua and in the moana. This inextricable connection via whakapapa within te taiao is a key difference between Māori scholarship and dominant science and illustrates the added value of science undertaken through a te ao Māori lens.

Understanding species

Papers connecting to this theme focus on understanding the ecology of specific species, and they draw from both mātauranga Māori and dominant science (Table 1). Selected

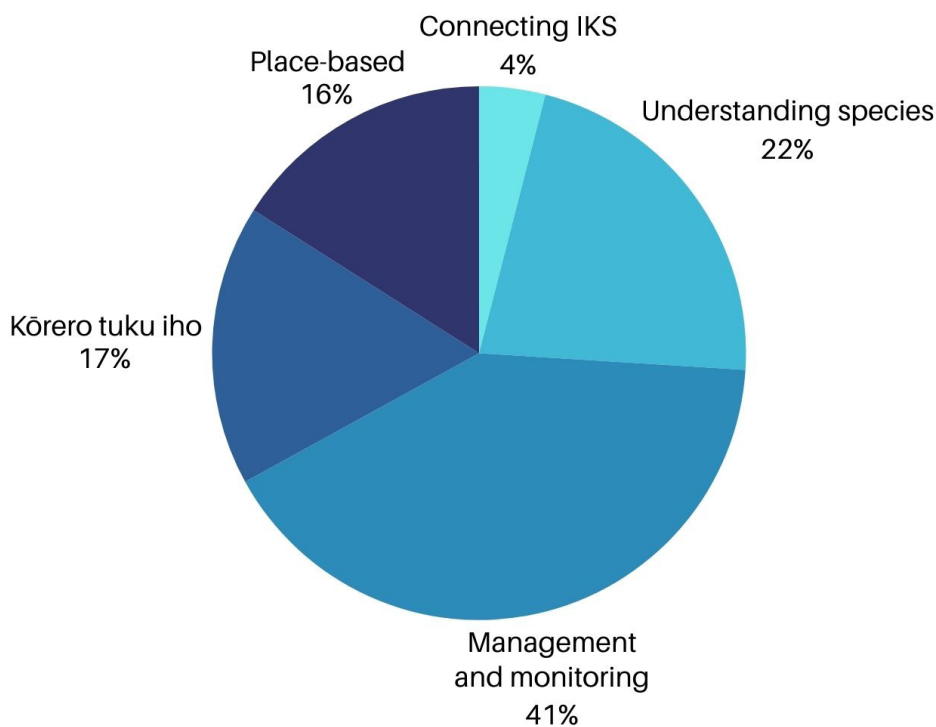


Figure 2. A pie chart showing the distribution of papers in each of the five themes (n = 81). IKS stands for Indigenous knowledge systems and kōrero tuku iho is one of the five identified themes which draws from history and oral traditions.

Table 1. Selected examples of research included in the understanding species theme to illustrate the breadth of research/methodological approaches and how they interacted with mātauranga and iwi/hapū.

| Study species | Aim of research | Methodological approaches | Mātauranga used | Iwi/hapū involved | References |
|--|--|---|--|--|------------------------------|
| Pātangaroa eleven-armed seastar (<i>Coscinasterias muricata</i>) and kuku green-lipped mussel (<i>Perna canaliculus</i>) | To use both mātauranga Māori and marine science to advance understanding of a degrading harbour, relating to the predation of kuku by pātangaroa | Predator-exclusion experiment using metal, plastic and natural cages made from traditional Māori material. | Intergenerational knowledge from kaumātua identified the location of restoration stations based on traditional kuku distributions, traditional material used to make natural cages. Using ngā tohu o te taiao to assess the health and status of ecosystems. | Ngāti Awa, Te Ūpokorehe | Paul-Burke et al. (2022) |
| Toheroa (<i>Paphies ventricosa</i>) | Review human interactions with toheroa to inform future management strategies | Ecological literature reviewed, including Treaty of Waitangi claims and then meetings with local experts in Taitokerau, Kāpiti-Horowhenua and Murihiku | Mātauranga from local knowledge holders and from pūrākau | Kaitiaki from Ngāi Tahu; Ngāti Raukawa; Ngāti Whātua; Ngāpuhi; Te Uri o Hau; Te Roroa; Te Rarawa; Te Aupouri; Ngāi Takoto and Ngāti Kuri | Ross et al. (2018) |
| Taramea (<i>Aciphylla species</i>) | Explore knowledge, derived from both scientific study and mātauranga Māori, on Taramea | Review historical material published on taramea to provide context for detailed scientific study into the intraspecific phytochemical variation within some species of <i>Aciphylla</i> | Exploring Ngāi Tahu uses of taramea from historical written references | Ngāi Tahu | Dobson-Waitere et al. (2022) |

examples in Table 1 illustrate the varying extent to which Māori (knowledge and people) have been interacted with in papers within this theme. Methodological approaches focused on mātauranga vary from capturing knowledge from kaumātua and local knowledge holders to using pūrākau to inform understanding of specific species (Table 1). Focus areas include advancing understanding of specific species that are both important for cultural harvest like kiore (Wehi et al. 2021), kiekie (Coombes 2007), tītī (Kitson & Moller 2008; Moller et al. 2009a, 2009b; Geary et al. 2019), taramea (Dobson-Waitere et al. 2022) and toheroa (Ross et al. 2018), or species which threaten the mauri of ecosystems, like pātangaroa (Paul-Burke et al. 2022a) and kauri dieback (Bradshaw et al. 2020; Table 1). Many of these papers seek to understand a particular species through both a Māori lens and a Western lens. For example, Watson et al. (2015) estimate the population abundance of kekeno (*Arctocephalus forsteri*) pups on Bench Island using mark-recapture surveys and complemented this with conducting interviews with kaumātua to find out where seals were present or absent in the past. Other papers (i.e. Rayne et al. 2022), highlight the importance of building trusted partnerships with mana whenua to enhance research. They stress the importance of the context that place-based knowledge provides for the interpretation of genomic data.

Approximately half of the papers in this theme seek to understand species which are important for sustainable cultural harvest (i.e. Coombes 2007; Kitson & Moller 2008; Moller et al. 2009a, 2009b; Ross et al. 2018; Geary et al. 2019; Barber & Higham 2021; Wehi et al. 2021; Dobson-Waitere et al. 2022). Much of the research contained within these papers moves beyond the elementary stage of developing relationships with Māori and instead illustrates rangatiratanga in the reclamation of harvesting mahinga kai (process of gathering food). These papers highlight the importance of an active conservation ethic for Māori and also show how the Western conservation ethic of preservation and protection is at odds with Māori understandings of the world. Wehi et al. (2021) highlight how species which some consider to be pests can also become culturally important through their research on kiore; they use Western science to assess the health of populations on Mauitaha Island, which Ngātiwai would like to safeguard cultural access to. They argue that conservation needs to be transformed with the inclusion of Indigenous perspectives. Coombes (2007) extends this idea in their exploration of postcolonial conservation and kiekie harvests, emphasising that the competing interests between state agencies and Māori can be addressed by devolving management and power and doing collaborative science.

Many articles within this theme (including Kitson & Moller 2008; Moller et al. 2009a, 2009b) were produced from the research partnership between scientists, particularly Henrick Moller, and Rakiura Māori, which investigates the cultural harvest of tītī | Sooty Shearwater (*Puffinus grius*). This programme of research remains one of the few long-term programmes that provides an excellent demonstration of potential pathways for good relations between Māori communities and scientists (Wehi et al. 2019).

Multiple papers within this theme explore traditional ecological knowledge (TEK) obtained through interviewing kaumātua. Some, like Moller et al. (2009a), compare knowledge about tītī gained from Māori to scientific measures and found TEK and science often agree on a pattern, like earlier tītī emergence in certain places, but are likely to have different explanations for an observed pattern. Geary et al. (2019)

highlight how government-imposed bans on harvesting species like tītī have resulted in a loss of mātauranga and intergenerational transmission of knowledge, and remind us that cultural harvests must be considered when deciding conservation management strategies.

As well as exploring the management and ecology of taonga species, there were also papers which used mātauranga to address problems with invasive or pest species (Ogilvie et al. 2019; Bradshaw et al. 2020; Palmer et al. 2020; Black et al. 2021; Paul-Burke et al. 2022a). For example, Paul-Burke et al. (2022a) showed that mātauranga can assist with controlling problem species by investigating ngā tohu o te taiao pertaining to the overabundance of pātangaroa in the Ōhiwa Harbour. Ogilvie et al. (2019) approached pest species from a different lens and focused on developing a more culturally accepted rodenticide than 1080. They showed that a naturally occurring toxin found in tutu (*Coriaria arborea*) was an effective rodenticide and highlighted that mātauranga should be used to identify alternative pest control tools. These papers highlight that Māori views of what constitutes a pest species are not limited to Western binary ideas of non-native vs. native. Instead, they emphasise the importance of balance and mauri of ecosystems, which can be disturbed by the overabundance of certain native species.

Connecting Indigenous knowledge systems

In recent decades there has been a global acknowledgement of the connectedness of Indigenous knowledge systems. This connectedness is related to the similarities, despite geographic differences, in how knowledge is developed and borne from a close physical, cultural, and spiritual relationship with te taiao. Papers within this theme focused on connecting Indigenous knowledge systems globally. Authors explored differences and similarities between Māori knowledge systems and those belonging to Quechua and Dusun people (Ulluwishewa et al. 2008; Huambachano 2018, 2019). Ulluwishewa et al. (2008) explored how Indigenous knowledge informs natural resource management for Dusun people in Brunei Darussalam and Māori in Aotearoa. They found, despite significant differences in local environments, that there were striking similarities between the two knowledge systems in terms of concepts, principles, strategies, and technologies. Huambachano (2019) compared traditional ecological knowledge systems of Māori and Quechua peoples. This study showed that TEK is central to Māori and Quechua peoples' values around food and highlight that it informs farming practices and processes. It contends that restoration of Indigenous peoples' food systems could advance both cultural knowledge and self-determination. While all other themes were Aotearoa focused, papers on the topic of connecting Indigenous knowledge systems remind us that we are part of a larger network of Indigenous People globally who are connected through a shared connection to Papatūānuku, similar belief systems, and, at times, through whakapapa.

Kōrero tuku iho - drawing from histories

Some papers in this theme explicitly focus on oral tradition and draw from past histories to determine future directions. For example, Whaanga and Wehi (2017) utilise Māori voices from 19th century niupepa Māori (Māori newspapers) to examine the shifts in Māori discourse around conservation from early colonisation to the modern context. The authors found that references to "kaitiakitanga" replaced references

to “rāhui” with time, signaling a higher level of concern with colonisation and its negative effects on kaitiaki practices. Similarly, Wehi et al. (2013) examined shifts in whakataukī (proverbs) relating to marine resources through time and found that references to specific species decreased with time while generic references to the marine environment increased. Again, this may be understood through reference to colonial history and the depletion of kaimoana (seafood) across the country. Modern efforts to recognise mātauranga Māori must take these histories into account, as focusing only on recent views (as Western science often does) results in the absence of important context as well as failing to recognise the mana of tūpuna Māori.

Many papers within this theme also focused on the actions and views of tūpuna Māori (ancestors) with respect to natural resources. Mercier et al. (2022) found that modern day pest insects were often repurposed for useful purposes, demonstrating the resourcefulness of Māori ancestors. Similar kōrero are often had around waste and are important to consider for modern science, which is increasingly interested in the concept of a circular economy. Other papers discussed the knowledge of tūpuna Māori on environmental issues such as natural hazards (King et al. 2007; King & Goff 2010) and sustainable kai management (Williams 2012).

Management and monitoring

Many papers focused on the positionality and opportunities for mātauranga Māori within environmental management in Aotearoa. This was the largest theme, comprising 41% of papers investigated. This is unsurprising given the significance of natural resources in te ao Māori, and the unique space for mātauranga Māori which has been carved by the legal context in Aotearoa.

Papers within this theme demonstrated several distinct power relationships between the statuses of Indigenous and dominant/Western values and knowledge. For the purposes of this analysis, we have grouped the papers under this theme into two sub-groups based on how they present this power relationship. These are: (1) incorporation of te ao Māori values and/or mātauranga into existing management tools, and (2) blending of Māori and Western knowledge and values to tackle key environmental issues, resources, or species of interest. Additionally, we have highlighted some exemplary papers which showcase a self-determination based approach focused on upholding tino rangatiratanga for Māori resources.

Incorporating Māori values into environmental management tools

Many of the papers under the management theme follow a similar pattern whereby the value of mātauranga Māori is discussed as contributing to and enhancing existing Western tools for environmental management. It should be noted here that for a paper to be included in this review we required that there was some discussion of mātauranga Māori. Thus this theme is not intended to describe tokenistic approaches to mātauranga in natural resource management, but rather to discuss power dynamics at play.

Papers in this sub-theme tended to approach resource management predominantly using tools that are informed by dominant Western law and policy, and advocate for the recognition of the value of te ao Māori values to add to/improve this structure. This is reflected in the types of language used, for example (emphasis added): “tools for **incorporating** cultural values into freshwater management”

Crow et al. 2018, p. 1), “**Incorporating** Māori values into land management” (Crow et al. 2020, p. 431), “how the watchfulness of Māori **complements and contributes** to disaster risk reduction” (Lambert & Mark-Shadbolt 2021, p. 368), “**Making room** for Indigenous knowledge in river management” (Parsons et al. 2019, p. 95), “**Integrate** indigenous peoples’ values” (McMurdo Hamilton et al. 2021, p. 1162), “Key Māori values **strengthen** the mapping of forest ecosystem services” (Lyver et al. 2017, p. 92), and “**Weaving** mātauranga into environmental decision-making” (Jones et al. 2020, p. 49).

The most crucial characteristic of these papers was the power dynamic between Māori knowledge, values, and people, and Western knowledge, values, and people. The shared language used within this sub-theme speaks to the historic lack of respect for Māori values and knowledge within New Zealand’s resource management system and broader culture. Rather than the inherent value of mātauranga Māori being treated as a given, papers must argue for the incorporation of Māori knowledge into a Western system and justify the value that mātauranga Māori brings. This means that many of the papers within this sub-theme were somewhat limited in the ideas explored. These limitations were not caused by a lack of care or understanding of mātauranga Māori in the authors themselves, but rather by the social context of a system which fails to prioritise Indigenous Peoples and leaves Indigenous scholars having to justify our own existence.

Another key characteristic of this sub-theme is a focus on pan-Māori issues and values, rather than on experiences or discussions of relationships with mana whenua in specific areas (as explained earlier mātauranga-a-hapū and local tikanga are central to the true understanding of and honouring of Māori knowledge). This means that a focus on local knowledge and engagement with mana whenua is less prioritised than in other papers which take more of a local case study approach (see the place-based research theme).

Connecting mātauranga Māori and Western science to address specific management issues

Many papers in the resource management sub-theme discussed mātauranga Māori through specific case studies which took a Māori approach to understanding and managing the taiao. These case studies focused on a broad range of issues such as water quality (Morgan 2006), river health (Tipa 2009; Harmsworth et al. 2011; Tipa et al. 2017) marine management (Kaiser et al. 2019), fisheries (Jackson 2013; Ogilvie et al. 2018), forestry (Lyver et al. 2018), and soil (Hutchings et al. 2018), as well as taonga species such as kōura (crayfish; Kusabs et al. 2018), mussels (Paul-Burke et al. 2018, 2022b; McEwan et al. 2020), and kānuka (Lawrence et al. 2019). Many of these papers overlapped with the place-based research theme, but we have chosen to also highlight them here to show the prevalence of environmental management within the research topics.

The papers within this sub-theme tend to utilise mātauranga Māori and Western science as complementary approaches to specific problems. These studies recognised the value of mātauranga Māori as a given (Paul-Burke et al. 2018) and this was often highlighted in research methodologies which specified the use of Kaupapa Māori research methods. Some key quotes from papers in this sub-theme highlight the blending of mātauranga and Western science as well as providing some contrasts with the earlier sub-theme of incorporation of knowledge: “The MMAP was **grounded by localised mātauranga Māori** and the principle of whanaungatanga (relationships); and sought to advance an inclusive harbour

wide monitoring approach” (Paul-Burke et al. 2018, p. 546), “mātauranga Māori not only offered the **underpinning drive** for a new programme of research but was also used to **develop and frame** the research questions and approaches” (Ogilvie et al. 2018, p. 598), and “in addition to the **necessary privileging of Ngāti Rangitihi mātauranga, tikanga and kaupapa**, due to the nature and complexity of the issues, the methodology also required that whatever process we used had the ability to incorporate science and technical information” (Hikuroa et al. 2018, p. 648). These papers often had a Māori lead author and/or co-authors, and studies were designed alongside specific mana whenua (iwi or hapū) groups focused on their local issues and communities.

Expressions of self determination in resource management

Within both sub-themes above there were key examples which we have chosen to highlight as being exemplary expressions of tino rangatiratanga in environmental management. These examples may fall into either or both the above sub-themes and have several key characteristics: (1) Māori are the main drivers of mahi and/or key decision makers, (2) the inherent value of mātauranga Māori is respected and understood, and (3) there is meaningful reflection on histories of colonisation and oppression of Māori knowledge.

Dick et al. (2012) presents interviews with kaitiaki to discuss the ecological and cultural consequences of loss of biodiversity in coastal ecosystems for Māori. This study centres the voices of mana whenua, with quotes from the interviewees making up a large part of the results section. In this way, Māori, and specifically mana whenua, are driving the direction of the research. This is a focus which is often missed by studies which take a broader pan-Māori approach. A key result of this study was the kaitiaki focus on the “interconnectedness of physical and spiritual realms, of people and nature, and of bio- economic and cultural needs” (Dick et al. 2012, p. 129), which led to the conclusion that degradation of the environment directly affects Māori identity.

Parsons et al. (2021) discusses river management in the Rangitāiki Plains of Aotearoa and how successive government policies, actions, and decisions have created negative outcomes for these environments. The paper demonstrates how these decisions can be traced back to Māori dispossession and the intentional marginalisation of mātauranga Māori. The authors argue that power relations and cultural values which underpin government decisions are often rendered invisible by the normalisation of the dominant culture as universal and the ignoring of other cultures. Such discussions provide a meaningful acknowledgement of the historical undervaluing of Māori knowledge and values. Yet the ongoing actions of the colonial government and Pākehā values were rarely discussed in depth (likely in part because of the Pākehā normalisation and invisibility). However, it did highlight that meaningful reflection on colonisation (both its historical context and ongoing existence) is needed in order for equity for mātauranga Māori to be achieved.

Discussion

Key findings

Lack of institutional support for Indigenous scholarship

The Western academic publishing system remains a key site for assertion of Indigenous scholarship and this review

highlights that, within this arena, there has been increased interest in the interface of mātauranga Māori and science. This has occurred, arguably, with an increased acceptance by Western-trained academics that mātauranga Māori is a valued knowledge system. There remains a distinct paucity of studies that use Kaupapa Māori methodologies, which mirrors the government’s chronic underinvestment in Kaupapa Māori research (Martin Jenkins 2023). The lack of capability and capacity of our research system to adequately support Māori researchers was reflected in the fact that only 60% of papers we analysed appeared to have Māori first authors. This is unsurprising given the experiences of the few Māori in science in Aotearoa (McKinley 2002; Haar & Martin 2022; McAllister et al. 2022a, 2022b). Within the academic sphere, there is a distinct privileging of international journals that contributes to the academic prestige economy. For example, in many of New Zealand’s universities, publication in highly-ranked, international journals is critical for academic promotion and progression. However, research that draws on highly localised knowledge is not always understood by international journals and their audiences. Additionally, concepts and ideas which are well understood by Māori need to be explained at length to an international audience, which also may contribute to the majority of papers being published in national journals. Therefore, it is unsurprising that the majority of papers (64%) of this review were published in New Zealand-based journals.

Importance of networks and key sites of Indigenous research

Papers that we analysed were connected by the themes of understanding species, place-based research, monitoring and management, kōrero tuku iho and connecting Indigenous knowledge systems. Across all five themes, we noted that there were broad interconnections between Indigenous researchers and locations, a meta-theme which we have conceptualised as ‘people, places and projects’ (Fig. 3). Individual scientists often had a wide impact, such as Dr Phil Lyver, who led a significant number of papers in this space. We could see the impact these individual scientists had on training and supervising other Māori scientists who then went on to publish and lead their own projects in the mātauranga/science space. Many publications also originated from particular institutions (such as Manaaki Whenua) and/or from research projects focused in specific locations (e.g. Te Urewera; see the place-based research theme). This further highlights the importance of researcher networks in Indigenous environmental scholarship.

Moving from consultation with Māori to co-development and enabling rangatiratanga in research

We observed an overall maturing of scholarship at the interface of mātauranga Māori and science over the past two decades. Rather than mātauranga being relegated to contextual information, there now appears to be an increase in genuine efforts to engage with mātauranga Māori. For example, in some earlier papers the extent of mātauranga Māori presented was a brief mention of Māori knowledge in the introduction. In comparison, in more recent scholarship localised mātauranga Māori is foundational in the development of research addressing environmental problems (ie. Paul-Burke et al. 2022a, 2022b). There is a growing consensus within the scientific community that we should be moving from tokenistic consultation with Māori to co-developing research with iwi and hapū. This was particularly apparent in the scholarship in the theme of management and monitoring, where there has been an evolution from incorporating Māori values into what remains a Western

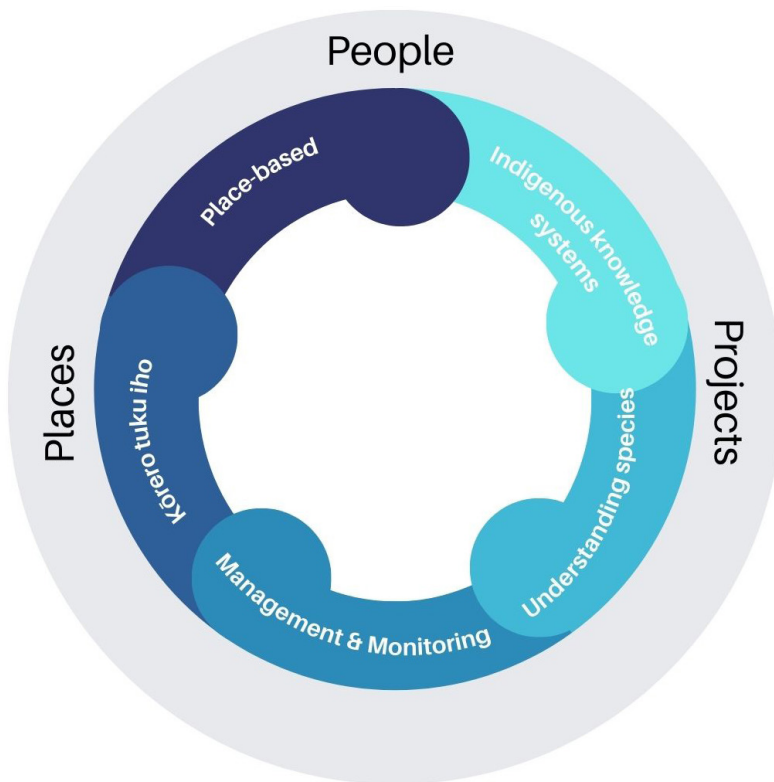


Figure 3: Diagram showing that connecting and transcending all five themes were key people, places, and projects. Key people repeatedly authored papers and trained other researchers on how to respectfully engage with Māori knowledge and people. There were also key places (i.e. Manaaki Whenua) and projects (i.e. the tītī project) where research engaging with mātauranga was supported.

management paradigm towards empowering mana whenua to exercise rangatiratanga over how their taiao is managed.

In recognition of the value we bring to teams, there also appears to have been an increase in the inclusion of Māori authors, including iwi and hapū partners, in authorship positions, which could represent a subtle shift from researched to researcher (Smith 2012). It is important to note that the inclusion of Māori practitioners and academics in research does not equate to rangatiratanga in research. Instead, rangatiratanga in research can look like shifts in power, control, Kaupapa Māori research methods and rangahau (as opposed to research) by Māori, for Māori. We see rangatiratanga in this space as being many different things, including shifts in recognition of what constitutes expertise and whose knowledge counts and is valid within journals. Rangatiratanga could look like an increase in entire papers exploring mātauranga Māori, rather than only considering mātauranga Māori and its relationship to western science. In order for mātauranga Māori to develop in the future as a knowledge system it also needs to develop independently. In the context of the Western academe, we support two distinct knowledge systems being used alongside one another when appropriate to address environmental problems and to build new understandings.

As highlighted by Broughton and McBreen (2015), through the Waitangi Tribunal (2011, p. 571) “scientists work well with kaitiaki whose mātauranga is of clear benefit to their projects, but research based on mātauranga itself is being neglected”. This remains true 15 years later. This is driven, in part, by a research sector founded on Western research traditions, where the privileging of Western science is structurally embedded into all mainstream educational institutions. We exist within a research ecosystem where the supremacy of the dominant knowledge system, despite attempts to remedy this such as MBIE funding and the implementation of the VM policy, is

overwhelming and pushes mātauranga to the margins. There are, however, examples of how some kairangahau (researchers) are (re)centring mātauranga Māori, which disrupts colonial norms which are so deeply embedded and engrained in research in Aotearoa. For example Paul-Burke et al. (2022b) in a collaboration between kaumātua, a master weaver, and researchers, created taura kuku (biodegradable spat settlement lines) out of traditional materials to enhance mahinga kai.

Tensions between Māori and Western communication landscapes

Māori knowledge communication landscapes differ significantly from Western academic traditions, which is unsurprising given their distinct epistemological foundations. Some scholars argue that the place for mātauranga is not within Western institutions or academic journals, as Māori communities have their own ways of disseminating knowledge. Allport et al. (2023) emphasise the importance of mahi toi (art), pōwhiri (particularly whaikōrero and karanga), wānanga, and pūrākau as methods of sharing mātauranga. In contrast, Western research dissemination predominantly involves publishing peer-reviewed books and journal articles, and presenting at academic conferences. These methods can be inaccessible to those outside the research community due to paywalls and high conference attendance costs, widening the gap between researchers and communities.

The audience of the papers reviewed here (and this article itself) is likely to be primarily Western-trained academics. While we arguably risk further privileging Western modes of research dissemination, it is worth taking stock of how mātauranga Māori is being presented within this forum and characterising the ongoing challenges and opportunities. The tension between publishing (or perishing) and fulfilling our roles as Māori researchers is a constant struggle. This review,

which collates only peer-reviewed journal articles, represents just a single drop in the ocean of mātauranga Māori. We acknowledge that this review covers only a small portion of existing research that includes mātauranga and relates to te taiao. While academic journals may represent the pinnacle of knowledge creation for Western-trained academics, Māori knowledge exists abundantly beyond the confines of journal articles. It is found in mōteatea (chants), whakataukī, pūrākau, maramataka (lunar calendars), and more. Nevertheless, given the growing number of journal articles exploring mātauranga and related topics, we consider it helpful to review the literature to date.

It is crucial to consider the politics of knowledge creation within academic publication, particularly how racism and exclusion are entrenched in this process. Academic journals often act as gatekeepers, especially within Western research contexts, wielding the power to determine whose knowledge is deemed valid. Although this review does not delve into the specifics of how the review process, eurocentrism in methods and languages, citational practices, and editorial gatekeeping impact what gets published (Hyland 2016), it is important to acknowledge that these factors significantly shape and, to some extent, limit the journal articles analysed in this review.

Special issues as an emerging space for mātauranga Māori

This review underscores the significance of special issues in advancing scholarship at the intersection of mātauranga and science. Between 2018 and 2020, the *New Zealand Journal of Ecology*, the *New Zealand Journal of Marine and Freshwater Ecology*, and the *New Zealand Science Review* each published special issues dedicated to mātauranga Māori. These issues featured experienced external editors with expertise in mātauranga Māori, helping practitioners to navigate the often challenging process of submitting manuscripts to mainstream science journals. As a result, there has been a notable increase in the number of papers exploring the interface between mātauranga and science. However, none of these journals have continued to support subsequent special issues on mātauranga, highlighting the need for journals to more proactively support research which centres mātauranga Māori.

Mercier and Jackson (2023) highlight the paradoxical challenges faced by Indigenous scholars who must navigate another worldview while communicating Indigenous knowledge within a Western science system. They describe their experiences editing the *New Zealand Science Review*'s special issue on mātauranga, pointing to differences in governance practices between mātauranga and science as a source of tension. Although the special issue provided a much-needed space to explore mātauranga Māori, it also led to problems when the journal subsequently published a racist letter to the editor. This incident is not isolated to individual journals and has been mirrored recently in *Science* (see responses to Black & Tylianakis 2024).

Journals, particularly science journals, still have significant work to do to meaningfully support Indigenous scholarship. This review highlights the importance of special issues as repositories for articles that engage meaningfully with mātauranga Māori. However, papers drawing from Indigenous knowledge should not be confined to special issues alone.

Ka mua, ka muri (conclusions)

Colonisation disrupted Māori intellectual traditions through the systemic theft of lands and suppression of Māori language,

traditions, and expertise. Rebuilding what we can and creating a new vision for rangahau and its broader role in rangatiratanga is complex. It will require not only growth in the Māori research workforce but also nurturing of mātauranga, particularly Kaupapa Māori methodologies, and activation of the research sector to better serve iwi and hapū needs.

We have observed a shift in the research landscape, moving from tokenistic engagement with Māori people and knowledge to creating space for mana motuhake and rangatiratanga in research. There have been some changes in power dynamics, with a move from the native informant role to recognising the expertise of mātauranga Māori practitioners in co-authorship positions. However, the pressure on researchers to publish numerous papers still largely controls how knowledge is disseminated. It is important to acknowledge that journal articles, including this review, are written for a specific audience, often not the communities we, as Māori researchers, aim to serve. In the future, we hope to see a shift away from journal articles as the pinnacle of research dissemination and other forms of knowledge dissemination recognised as valid and valuable.

Research at the interface of Indigenous knowledge and science is continuously evolving as Indigenous researchers reclaim traditional knowledge and practices. This review documents the progress made in published research at this interface in the context of Aotearoa. The journal articles analysed in this review indicate that there is still work to be done in decolonising the research process. Research conducted in Aotearoa, as part of a global research system, continues to privilege Western knowledge systems and methodologies, and at times, perpetuates colonial harms. Power within the research sector still largely resides with predominantly white institutions and Western-trained academics. We would like to see a shift of funding and resources directly to iwi, hapū, and Māori organisations as a step towards redressing current power imbalances within our research system.

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Supplementary material

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Appendix S1. Review citations spreadsheet.

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