









## Using te reo Māori and ta re Moriori in taxonomy

Andrew J. Veale<sup>1,2\*</sup> , Peter de Lange<sup>1</sup> , Thomas R. Buckley<sup>2,3</sup> , Mana Cracknell<sup>4</sup>,  
Holden Hohaia<sup>2</sup>, Katharina Parry<sup>5</sup> , Kamera Raharaha-Nehemia<sup>6</sup>, Kiri Reihana<sup>2</sup> ,  
Dave Seldon<sup>2,3</sup> , Katarina Tawiri<sup>2</sup>  and Leilani Walker<sup>7</sup> 

<sup>1</sup>Unitec Institute of Technology, 139 Carrington Road, Mt Albert, Auckland 1025, New Zealand

<sup>2</sup>Manaaki Whenua - Landcare Research, 231 Morrin Road, St Johns, Auckland 1072, New Zealand

<sup>3</sup>School of Biological Sciences, University of Auckland, 3A Symonds St, Auckland CBD, Auckland 1010, New Zealand

<sup>4</sup>Rongomaiwhenua-Moriori, Kaiangaroa, Chatham Island, New Zealand

<sup>5</sup>Massey University, Private Bag 11222 Palmerston North, 4442, New Zealand

<sup>6</sup>Ngāti Kuri, Otaipango, Ngataki, Te Aupouri, Northland, New Zealand

<sup>7</sup>Auckland University of Technology, 55 Wellesley St E, Auckland CBS, Auckland 1010, New Zealand

\*Author for correspondence (Email: andrew.j.veale@gmail.com)

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**Auheke:** Ko ngā ingoa Linnaean ka noho hei pou mō te pārongo e pā ana ki ngā momo koiora. He mea nui rawa kia mārama, kia ahurei hoki ngā ingoa pūnaha whakarōpū. Me pēnei kia taea ai te whakawhitiwhiti kōrero ā-pūtaiao nei. Nā tēnā kua āta whakatakotohia ētahi ture, tohu ārahi hoki hei whakahaere i ngā whakamārama pūnaha whakarōpū. Kua whakamanahia ēnei kia noho hei tikanga mō te ao pūnaha whakarōpū. Heoi, arā noa atu ngā hua o te tukanga waihanga ingoa Linnaean mō ngā momo koiora i tua atu i te tautohu noa i ngā momo koiora. Ko tētahi o aua hua ko te whakarau: (1) i te mātauranga o ngā iwi takatake, (2) i te kōrero rānei mai i te iwi o te rohe, (3) i ngā kōrero pūrākau rānei mō te wāhi whenua. Kei te piki haere tēnei āhua whakamahinga hei āwhina kia whakamanahia ngā iwi taketake i roto i te mahi pūnaha whakarōpū. Nā tēnā ka whakamanawahia te iwi i runga i tōna mōhio he hoa-rangapū ia i roto i te mahi whiriwhiri ingoa kōrero pūrākau. Kua roa noa atu a Aotearoa e whakamahi ana i te reo taketake o Aotearoa / Rēkohu rānei i roto i te mahi whakamārama pūnaha whakarōpū. Engari ahakoa tērā, kāore i te pērā rawa te kaha o te ao pūnaha whakarōpū ki te whakapiri mai ki ngā iwi taketake i roto i tēnei tukanga. Kei roto i te rangahau nei i arotakengia ngā tau ki muri, me te aha, ko tōna kitenga e pēnei na: mai i tau 1830, neke atu i te 1,288 ngā wā kua whakamahia te reo Māori, te reo Moriori rānei i roto i te pūnaha whakarōpū. Kei te piki haere hoki tēnei tatauranga. Ko tētahi kitenga o te arotake nei, ko te tohu atu i ētahi āhuatanga whakamahi i te reo Māori, reo Moriori hoki. Hei taurira: (1) ngā momo whakarerekētanga whakamahi o ngā kupu “Māori, Moriori” rānei hei tohu atu tērā i ahu mai tēnā momo koiora mai i Aotearoa. (2) ngā ingoa kōrero pūrākau Māori / Moriori mō ngā momo koiora; (3) ngā ingoa whenua Māori / Moriori hoki e whai hononga ana ki ngā momo koiora (4) ētahi ingoa whakamārama i hangaia mai i ngā kupu Māori / Moriori hoki me (5) ētahi ingoa hou kua whakaaraha e te iwi e mahi ngātahi nei ki te taha o ngā kaupūnaha whakarōpū. Ko tā mātou nei, he arotahi he tautoko hoki i te tuarima o ēnei āhuatanga. He pūnaha mahi ngātahi tēnei hei whakamārama i ngā momo koiora. Ka pēnei mā te āta titiro ki ētahi taurira. Ko ēnei taurira ka whakamiramira i ngā huanga me ngā uauatanga o tēnei pūnaha mahi ngātahi hei whakamārama i ngā momo koiora. Ka tuku āwhina hoki mātou hei ārahi i ngā kaupūnaha whakarōpū kia pai ake te whakapiri atu ki te iwi mō te whakamārama momo koiora. Ka mātua matapakihia ngā take e pā ana ki te “whakarōmahanga” o ētahi kupu Māori, te whakamahinga o te tohutō, me te hiranga hoki kia whakapiri atu ki te iwi mā te roanga atu o te tukanga whakaingoa. Ko tā mātou hoki e tohutohu nei kia kohia katoatia ngā ingoa reo Māori, reo Moriori hoki kia noho hei rārangi tohutoro mō te wā anamata hei ārahi i te whakamahinga, hei hanga pātengi raraunga hoki mō Aotearoa. Ko tēnei pātengi raraunga me māmā te tomo atu, me wātea hoki hei rauemi whakamahi mā te kaiarangahau.

**Abstract:** Linnaean names are an anchor for biological information about a species, and having clear, unique, taxonomic names is vital for scientific communication. Accordingly, there are specific rules and guidelines enshrined in codes that govern nomenclature and taxonomic description. The process of creating Linnaean names for species can however provide multiple functions beyond identification, including the incorporation of cultural knowledge, vernacular and place names as epithets. Increasingly this usage helps engage and empower Indigenous cultures in taxonomic work through a shared sense of ownership over the species and the choice of epithet. Aotearoa New Zealand has a long history of using both the indigenous Maori language – te reo, and

the Indigenous language of Rekohu (the Chatham Islands) – ta re Moriori, in taxonomic description, but not necessarily one of engaging Maori and Moriori in this process. Here we review this history, finding that since its first use in 1830, te reo and ta re have been incorporated over 1288 times within taxonomic nomenclature, and that this usage is increasing. We identify five central ways in which te reo and ta re have been incorporated, including the use of (1) variations of the words “Maori” and “Moriori” to designate Aotearoa New Zealand origins, (2) Maori / Moriori vernacular names for species, (3) Maori / Moriori place names associated with species, (4) novel descriptive names created from Māori and Moriori words, (5) novel names suggested by Maori in collaboration with taxonomists. We focus on and promote this last, collaborative system for species description through case studies that highlighting the advantages and the potential challenges of this process, and we provide guidance for taxonomists to better engage with iwi / imi in species description. Specifically, we discuss issues relating to the Latinisation of Maori words, the use of macrons, and the need for engagement of iwi / imi throughout the naming process. We also recommend creation of a central depository to log te reo and ta re names to act as a reference for future usage and provide a readily accessible electronic database for Aotearoa New Zealand people and researchers to use.

**Keywords:** Linnean taxonomy, taxonomic nomenclature, mātauranga Maori, Indigenous knowledge, traditional ecology knowledge, kaitiakitanga

## Introduction

“Ko te reo te mauri o te mana Māori” / “The language is the essence and pride of the people” Sir James Henare (1986; Waitangi Tribunal Report: Wai 11).

Current scientific taxonomic practice uses a binomial naming system first introduced by Linnaeus in the 1750s; his system has become standardised and formalised over the past 270 years. Within this system, specific rules have been established for naming species, both to avoid redundant descriptions, and to prevent the use of the same epithet for more than one species. These rules were introduced in the late 19th century and are continuously updated by international commissions of scientists (see <http://www.iczn.org> and <http://www.botanik.univie.ac.at/iapt/>) (Ohl & Lauffer 2018).

Examining how Indigenous languages are integrated into taxonomic naming processes can reveal relationships within society. Aotearoa New Zealand (hereafter Aotearoa) has two Indigenous languages: te reo Māori (hereafter te reo), traditionally spoken by the Indigenous people of the main islands of Aotearoa (and an official language of the country), and ta re Moriori (hereafter ta re), traditionally spoken by Moriori on Rekohu – Chatham Island. While there are obvious similarities between these two Eastern Polynesian languages, through centuries of cultural separation and linguistic evolution they have become distinct (Richards 2018). There are also a diversity of dialects and spellings within te reo Māori (Harlow 2006).

Formal Linnean taxonomy in Aotearoa began with the collections and mostly unpublished descriptions made by Joseph Banks and Daniel Carl Solander on Cook’s first voyage to the South Pacific between 1768 and 1771. The first formal descriptions of species from Aotearoa were included in the *Genera Plantarum* in 1775, published by Johann Reinhold Forster and his son (Johann) Georg Adam Forster (Earp 2013). To our knowledge, Banks, Solander and the Forsters did not incorporate te reo into their species names. Te reo has however been incorporated into taxonomy since the early 1800s. The first species we can find to have a Māori epithet was the North Island tomtit *Petroica macrocephala toitoi*, described by Lesson and Garnot in 1828. In te reo Māori ‘toitoi’ means to dart briskly, as this little bird does. Two years later, René Lesson created a new genus for the New Zealand tomtits – *Miro*, using another Māori vernacular name (*Miro*

has since been reduced to subgenus rank within *Petroica*). Similarly, in 1837 Lesson assigned the South Island mōhua to its own genus, *Mohua*, again adopting a vernacular Māori name. Lesson consistently tried to incorporate names used by Indigenous peoples for the animals that he described throughout his travels, with other examples including *Varanus douarrha* (Lesson 1830), a monitor lizard from New Ireland, Papua New Guinea, and *Coluber ikaheka* (Lesson 1830) a snake from New Guinea. However, some early naturalists such as Otto Finsch were highly critical of Lesson’s ‘practice of adopting local names to designate new genera on the grounds that it caused confusion’ (Buller 1870); William Forbes described Lesson’s use of te reo as “barbarous and confusing” (Forbes 1882). Walter Buller agreed with his mentor Finsch, thus preferring Frederic de Lafresnaye’s proposed genus *Orthonyx* instead of *Mohua* for his 1870 book.

Both te reo and ta re are now far more commonly used in taxonomy than they were in the early 19th century. Despite this, a significant proportion of taxonomic practitioners remain undecided about the relevance of incorporating te reo, perhaps assuming that Latin or Greek epithets are the ‘correct’ way to proceed. Some taxonomists appear reluctant to engage with or consult with iwi / imi over potential te reo and ta re name usage as epithets as this engagement is outside their knowledge sphere or expertise. Others actively decry the relevance of consulting with iwi / imi. These negative views towards incorporating te reo / ta re fail to acknowledge that Māori are joint partners under the Treaty of Waitangi, and that under the Waitangi Tribunal Wai 262 report there is recognition that Māori retain ‘kaitiakitanga’ (guardianship) over ‘taonga’ (treasured) species. Specifically, the Wai 262 report states that while “Māori have no proprietary rights in taonga species, the cultural relationship between kaitiaki and taonga species is entitled to reasonable protection” (Waitangi Tribunal report Wai 262). To us, this implies that for species of cultural relevance to Māori, there is an imperative to conduct processes such as formally naming and describing these species in partnership with Māori.

We begin with a comprehensive historical overview of how te reo / ta re has been incorporated into taxonomy to date. We then discuss a series of case studies highlighting collaborative naming processes. Finally, we provide a guide on how best to use te reo / ta re in future, by replicating the successes and avoiding the mistakes of the past. In this article our aim is to

promote the use of te reo / ta re in species nomenclature, and particularly the engagement of scientists with iwi / imi, and vice versa.

## Methods

### A historical review of te reo and ta re taxonomic epithets

To comprehensively review the historical incorporation of te reo and ta re in taxonomical epithets, we manually examined all species lists we could find from Aotearoa, across taxa. We attempted to identify and record every instance of te reo and ta re usage in epithets in genus and species and lower ranks (subspecies, varieties, and forma). Given the inconsistency in taxonomic lists and resources across taxa, gaps are probable. Nevertheless, this list should serve as a detailed resource for future analyses of te reo / ta re in taxonomy. References for the species lists examined are included in Appendix S1 Supplementary Materials.

We manually curated the species list, checking the etymology and range for species with names of uncertain origin where possible. We also used the New Zealand Organisms Register (see [www.NZOR.org.nz](http://www.NZOR.org.nz)) to search for common te reo and ta re word stems identified in the manual search. One difficulty in determining the etymology of species names is that there are several phonetically similar languages, including many Polynesian ones. For example, the generic name for the Aotearoa endemic mistletoe *Tupeia antarctica*, one of the earliest New Zealand flowering plant genera and species to be

described by Europeans (Chamisso & Schlechtendal 1828), sounds uncannily like one of its te reo vernaculars ‘tāpia’. However, the name actually honours Tupaia, the Raiatean priest, Arioi and Island Navigator who accompanied Captain Cook during his 1769–1770 voyage from Tahiti to Aotearoa and Australia: “...nomine *Taheitisensis amabilis peregrinatoris in primo Cookii itinere de scientiis bene meriti.*” [named after our Tahitian friend that traveled with us on Cook’s first journey of great scientific discovery] (Chamisso & Schlechtendal 1828; de Lange 2019).

We present and discuss four case studies to demonstrate collaborative naming processes. These are drawn from our own collaborations with iwi / imi and from the literature.

## Results and Discussion

We identified 1288 different taxonomic epithets containing te reo or ta re, with variability in frequency across different branches of the tree of life (Fig. 1). Gastropoda (snails, both marine and terrestrial) has by far the largest number of te reo / ta re epithets with at least 13 genera and 247 species, followed by Arachnida (spiders) with at least 37 genera and 120 species (Fig. 1).

While both of these groups have high numbers of species, and high endemicity – factors likely to increase the chances of them being named using te reo – these naming patterns can in part be explained by the practices of a few taxonomists who were (or are) immensely prolific in naming species, and in using

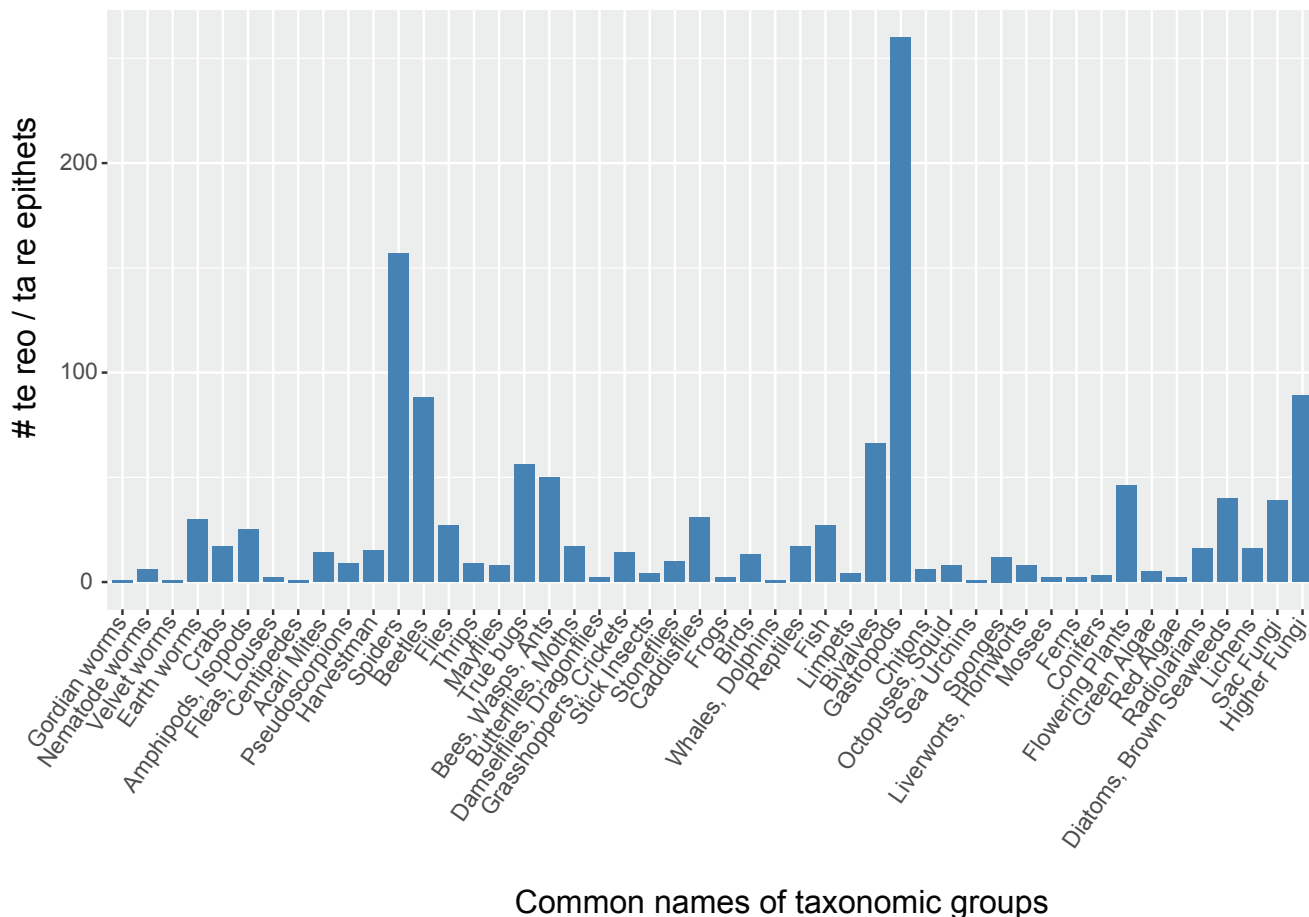


Figure 1. Total number of species recorded in each class of organism with a te reo / ta re epithet.

te reo / ta re epithets (Figs 2, 3). Ray Forster, an internationally renowned arachnologist, described over 670 species of Aotearoa spiders along with his co-authors (particularly CL Wilton and N Platnick) (Vink 2017). He included at least 35 genera and 106 species using te reo epithets. Most of these were Māori location names (e.g. *Synthetonychia wairarapae*, *Gasparia kaiangaroa*, *Haplinis taranakii*), but others are descriptive names such as *Duripelta mawhero* (māwhero means pink in te reo). Forster and his co-authors accounted for over 12% of all species with te reo epithets that we found. Arthur Powell, a mollusc taxonomist, was also a prolific assigner of te reo epithets, describing at least four genera and 114 species of gastropods, bivalves and a few other taxa in this way. More recently, Bruce Marshall of Te Papa (and colleagues, particularly Gary Barker) have added another 66 mollusc species with te reo epithets. No details were recorded regarding consultation and collaboration with iwi / imi for most of these scientists, and given their naming patterns primarily reflect broad geographical names, we assume that while they were at least enthusiastic about the use of Māori words, they primarily did this without consultation.

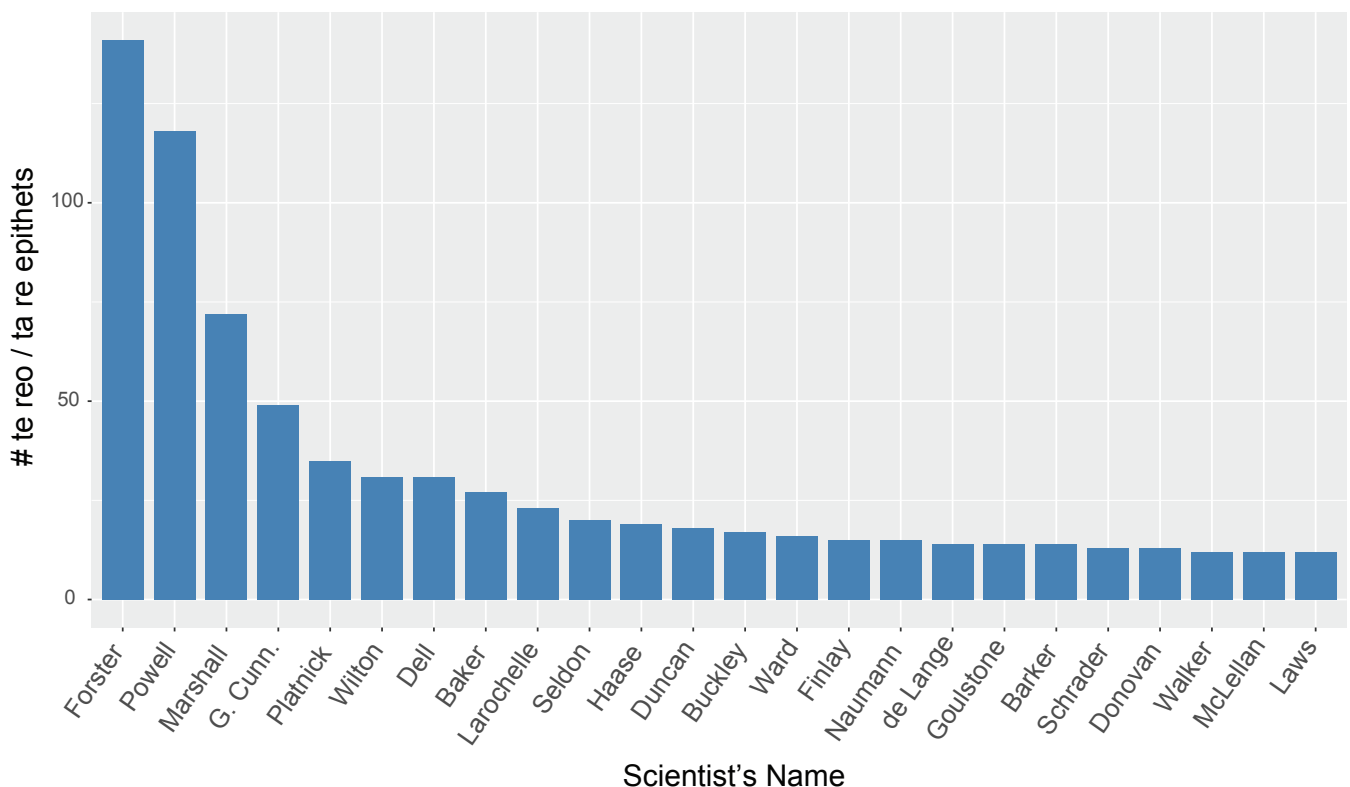
#### Using derivations of the words ‘Māori’ or ‘Aotearoa’

The most common te reo species epithets are derivations of the word ‘Māori’ (133 species, 35 genera) and ‘Aotearoa’ (75 species, eight genera). We assume that in most cases these two words signify that the species is native to Aotearoa (this was consistently the etymology given in the species descriptions we examined), and are therefore in most instances alternatives to the more common “*novae-zelandiae*” (or similar) found in 539 species, 16 genera.

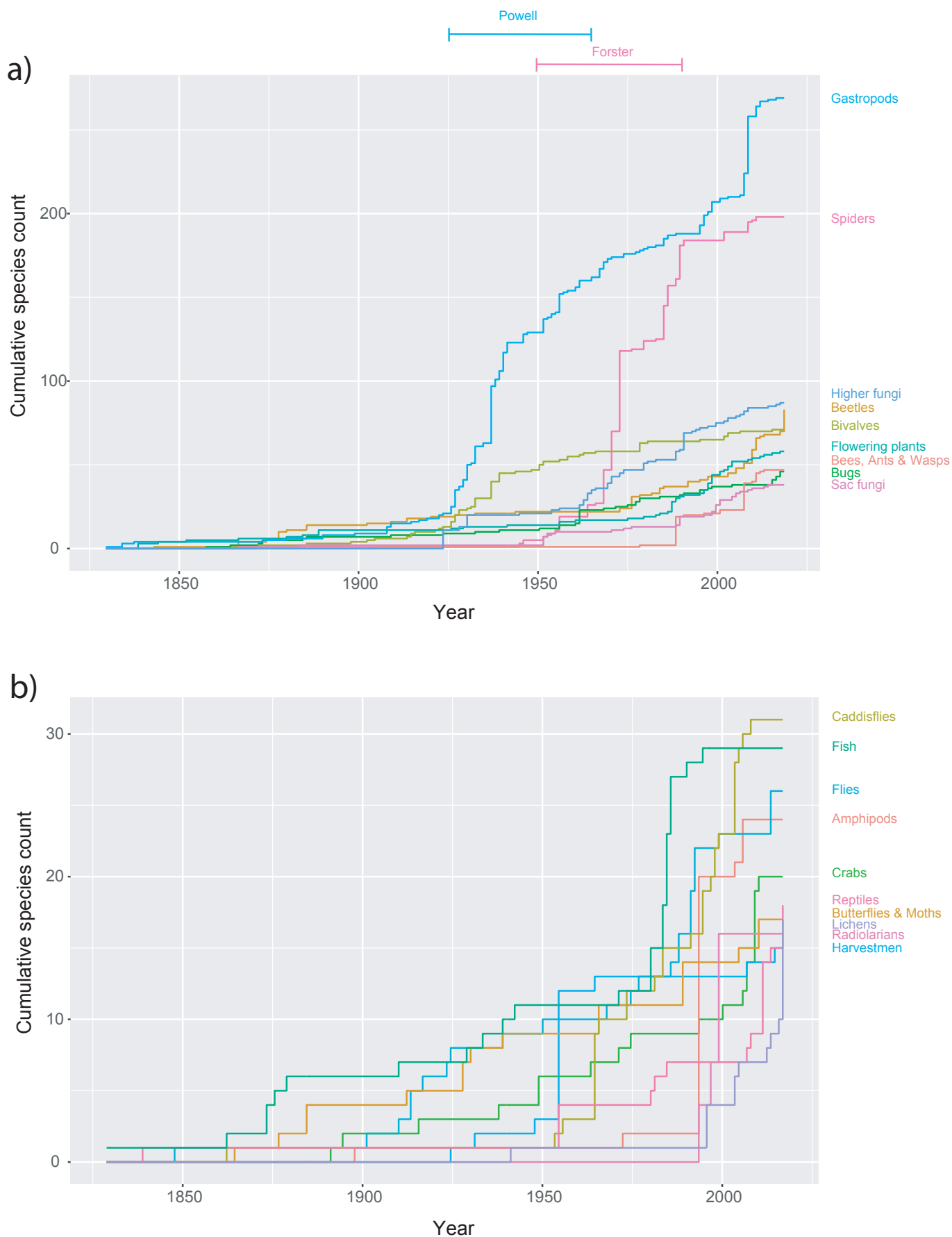
In most epithets, the word ‘Māori’ appears to mean ‘indigenous to Aotearoa’ and which is often stated in the

published etymologies of the species. However, there are instances where it may be construed (correctly or incorrectly) as referring to skin colour. The large black kekerengu (a cockroach) was first described as *Polyzosteria novaeseelandiae* in 1865, but it, along with five other species, were placed in a new genus *Maoriblatta* in 1966, a name derived from its common name the ‘Māori-bug’ (McLintock 1966). This common name is likely to be derived from a deplorable racial slur. Miller (1952) specifically calls out the inherent racism in the common name ‘Māori-bug’ saying: “the expression ‘Māori-bug’ will not be found [in this review]; it is a word just as offensive to the Māori as its odour is to the Europeans who coined the word”. Miller’s work (1952) is a fascinating ethno-entomological piece detailing mātauranga Māori, whakapapa (genealogy) and common names for Aotearoa insects. While we acknowledge that for the majority of occasions ‘Māori’ has been used as a species epithet it has been done with good intentions, in the 21st century, names such as Māori and Pākehā (the te reo word for a New Zealander of European ancestry) that could (even accidentally) associate the colour of an animal with the skin colour of an ethnic group are clearly inappropriate.

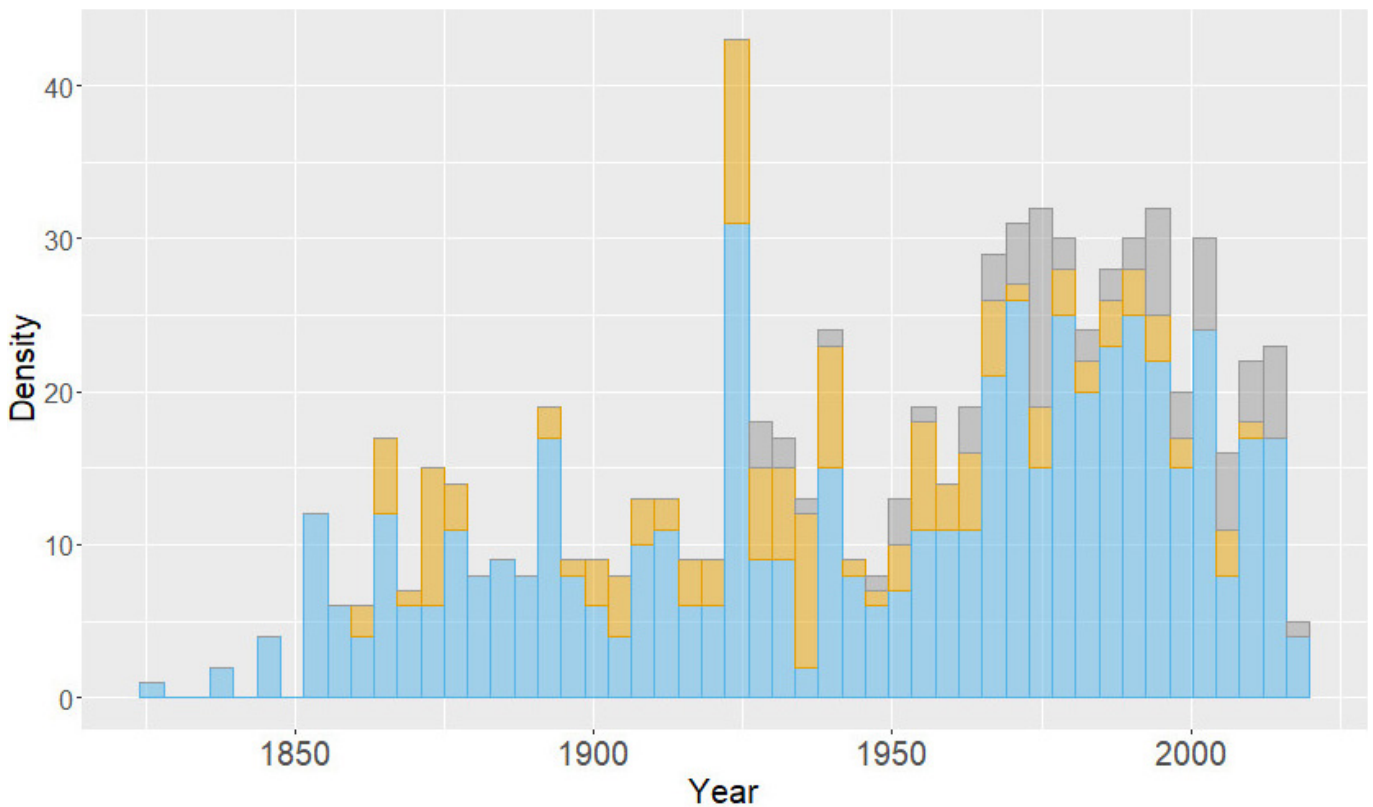
Comparing the frequency of these three words for species epithets over time shows some interesting trends (Fig. 4). The use of ‘Māori’ was first used in taxonomy in 1862 for the caddis fly *Oeconesus maori*, and increased in frequency through to the mid 20th century, with 36% of species epithets using this word (out of the three options) during the period 1926–1950. Although relatively common throughout most of the 20th century, its use has recently declined, representing only 4.2% of species out of these options since 2000. In contrast, variations on ‘Aotearoa’ were first used in taxonomy much later, beginning in 1926 for the dog’s foot cockle (*Cardita aoteana*) and the marine snail (*Nassarius aoteanus*), both described by



**Figure 2.** The number of te reo / ta re epithets created by the most prolific taxonomic users of te reo.



**Figure 3.** Cumulative number of species in each group with te reo / ta re epithets over time. (a) species with greater than 35 epithets, (b) species with fewer than 35 epithets. Also displayed are the active periods of R.A. Forster and A.W.B. Powell.



**Figure 4.** Historical counts of three species names that can be translated to mean ‘native to New Zealand’. Blue = “*novae-zelandiae*”, orange = “*maori*”, gray = “*aotearoa*”.

Harold Finlay. ‘Aotearoa’ has been increasingly used since then, with 23% of species since 2000 using this name out of the three options. The proportion of species named with some version of “*novae-zelandiae*” has consequently decreased, indicating a change in preference from this to ‘Aotearoa’. However, “*novae-zelandiae*” or different spellings thereof (at least 25 according to Webb & Edgar 1999) remains a common epithet for vascular plants. These changes in proportion of use appear to indicate that within taxonomy ‘Māori’ was seen as a socially acceptable and internationally understood identifier for indigeneity to New Zealand in the early 20th century however with increasing awareness within our postcolonial society this term is falling out of favor. At the same time, the te reo term ‘Aotearoa’ has been adopted increasingly as taxonomists increase their understanding of te reo, and as Aotearoa has become a more common and acceptable name for New Zealand.

#### Epithets beyond ‘Māori’ and ‘Aotearoa’

After ‘Māori’ and ‘Aotearoa’, most of the regularly used te reo or ta re word stems in taxonomic epithets are location names or descriptors, or the names of common trees which have many associated species. The most frequent Māori / Moriori epithets, after ‘Māori’ and ‘Aotearoa’, are in order: ‘Otago’ [based on ‘Otakou’], ‘Rakiura’, ‘Aupouri’, ‘Oamaru’, ‘Aotea’, ‘Tangaroa’, ‘Tōtara’, ‘Manawatawhi’ [Three Kings Islands], ‘Waipoua’, ‘Moriori’, ‘Hauraki’, ‘Reinga’, ‘Kopua’, ‘Mānuka’, ‘Kāpiti’, ‘Rekohu’, ‘Kaikoura’ and ‘Houhere’. Most of the regions that occur are relatively large (e.g. Otago & Hauraki) or have high levels of endemism (e.g. Manawatawhi, Cape Reinga). Oamaru is highly ranked because “*oamaruensis*”

has been used for 23 species of extinct marine diatoms found in Oamaru limestone. In contrast, the te reo vernacular name ‘tōtara’ is commonly used in species epithets, because many species associated with the tōtara tree (*Podocarpus totara*), such as the tōtara bud mite (*Eriophyes totarae*), various fungi (*Calyprella totara*, *Ceriporia totara*, *Phlebia totara*) and lichens (*Lecanactis totarae*), have been given its name. Similarly, species associated with the mānuka tree (*Leptospermum scoparium*), such as the mite *Aceria manukae*, gecko (*Naultinus manukanus*), and fungi such as *Hypocrea manuka*, *Nectria manuka*, and *Postia manuka* have been given this te reo vernacular name for the tree. The highest ranked (8th) te reo word stem that is not a place name is ‘Tangaroa’ the kaitiaki (guardian deity) of the near shore marine life and fishes of the great ocean of Kiwi. Notably, all of the species honoured with that name are marine species.

#### Ta re Moriori—the language of the tchakat henu (Indigenous people) of Rekohu and Rangihau (Chatham and Pitt Islands)

To our knowledge, only 19 species have been created using ta re words, all either derivations of ‘Moriori’ – the name of the people, or ‘Rekohu’ – the name of the main Chatham Island. Again, many of the species named for Moriori are marine molluscs that likely take their name from the Moriorian biogeographic region. However, more recently plants such as *Lepidium rekohuense* (de Lange et al. 2013) have been described. In most examples, imi were not consulted about use of ta re names. We advise that future naming of taxa endemic to the Chatham Islands should be done in partnership with the Chatham Island imi, who are keen to collaborate with scientists working on that island groups’ fauna and flora.

This research provides the first comprehensive of the incorporation of te reo and ta re in Linnaean taxonomy, and we were unable to find any similar reviews for other regions of the world or for other languages. While there are many articles on ethnobiological taxonomic practices (Turner et al 2013, Pinto et al 2016, Cadoso et al 2010), far less is written about how scientific practices incorporate traditional knowledge and Indigenous languages in taxonomy.

The importance of consultation with iwi / imi over deciding te reo / ta re name choice and usage cannot be stressed enough. One example of unintended bad practice suffices to exemplify the problem. *Coprosma waima* was established by Druce (1989) for a species of *Coprosma* endemic to southern side of the east–west range that separates the Waipoua Forest and river catchment from the Hokianga Harbour. The former New Zealand Forest Service referred to the range as the ‘Waima Forest’. Druce (1989) therefore assumed that the range was also known to local iwi as the ‘Waima Range’, and without consultation named his species accordingly. There is however no universal name for that region, which has complex iwi ownership. Druce’s decision unwittingly caused an insult to iwi on the southern side of the range in whose rohe the type locality falls. They assumed that the name was given to honour those iwi living at Waimā, a small settlement located between Rawene and Kaikohe. As a result of the subsequent confusion and complexity of finding an appropriate and widely agreed te reo epithetic related to this region, the subsequent recognition of other endemic plants from this range has generally steered clear of te reo epithet usage (de Lange et al. 2002; Heenan & Cameron 2002), though one endemic *Ackama nubicola* was bequeathed, through consultation with Ngā Puhi from Whirinaki the vernacular ‘turoa onamata’ (de Lange et al. 2002).

### Case studies

The process of incorporating te reo and ta re into taxonomic nomenclature can involve collaboration and partnership between scientists and iwi / imi. Ideally, taxonomic collaboration should extend beyond naming and include sharing knowledge and goals throughout the species discovery and description. Here, we present examples of collaboration in taxonomic naming.

#### Case Study 1: Botanical naming collaborations

There are many botanical examples of te reo / ta re usage. In the following examples, the naming process has been consultative in most cases, generally with hapū (tribal subunit) whose particular rohe (territory) the plant is either thought to be endemic to, or in which the type locality resides.

*Senecio repangae* is a species with two subspecies, the autonym subsp. *repangae* and subsp. *pokohinuensis* (de Lange & Murray 1998). The species epithet “*repangae*” was bequeathed by Ngāti Hei from ‘Repanga’: their name for the type locality, the island otherwise known as Cuvier Island. In this case, multiple iwi were consulted as the island, and the name associated with it, is shared by Ngāti Hei and Ngaati Whanaunga, though for this species the type locality fell within the Ngāti Ramuri hapū of Ngāti Hei. *Senecio repangae* subsp. *pokohinuensis* is endemic to the “Mokohinau Islands”, an island group that Ngāti Rehua hold mana whenua (territorial claim of authority) over. In this case the type locality is Burgess Island, known to Ngāti Rehua as ‘Pokohinu’, and as that iwi lack a collective name for the islands (the origin of “Mokohinau” is not clear) they preferred to use the te reo Māori name for Burgess Island (de Lange & Murray 1998).

*Coprosma spathulata* subsp. *hikuruana* (de Lange & Heenan 2001) is a subspecies endemic to the ultramafic belt of North Cape, Te Pahi. The species epithet “*hikuruana*” was bequeathed, following consultation with Ngāti Kuri elder Graham Neho, and it derives from the Ngāti Kuri name for the two points of land (Cape Maria Van Diemen and North Cape) which define the tail of Te Ika a Maui (the fish of Maui), the northernmost tip of the North Island of Aotearoa.

A more recent example concerns *Cardamine panatohea* (Heenan & de Lange 2018), a species of cress seemingly endemic to the upper slopes of Mt Ruapehu within the rohe of Ngāti Rangi. When the potentially new species was discovered in 2012 the authors held a hui (meeting) with the Ngāti Rangi Trust Board and suggested they play a role in the naming of the species. Following visits to the sites where the species grows, Ngāti Rangi bequeathed the name “*panatohea*” and in doing so they wished the etymology to be explained thus (Heenan & de Lange 2018; p. 259): ‘The te reo Māori epithet “*panatohea*” gifted by Ngāti Rangi who hold Mana Whenua over the portion of Ruapehu where this species grows originates from the names ‘panapana’, a common name for this type of cress, and ‘tītōhea’ which is the description of the land above the bush line on Mt Ruapehu. The term ‘tītōhea’ is usually translated to mean ‘barren’, but for Whanganui tribes it means a sacred area, usually desert or mountainous, where special species live. In giving this name for this specific Mt Ruapehu centred species, Ngāti Rangi wish to acknowledge the need for people of all nations and cultures to treat *C. panatohea* and Ruapehu with special care. The species epithet is therefore not only a name for a species but also serves as an encouragement to remember that Ruapehu is sacred to all Whanganui tribes and has notable cultural and natural heritage status.’

These examples reflect not only active consultation and informed discussion between taxonomists, rūnanga, or elders designated to have the right to make decisions for the rūnanga, but also the active decision to ‘Latinise’ geographical epithets e.g. ‘Hikuru’ as “*hikuruana*”; ‘Repanga’ as “*repangae*”, and ‘Pokohinu’ as “*pokohinuensis*”. This decision is a key point we will discuss later.

#### Case Study 2: Northland stick insect nomenclature

A new genus of stick insect was collected from forest remnants within the rohe of Ngāti Kuri in 2008 by Thomas Buckley and collaborators, who then consulted Ngāti Kuri on the name to bestow on this new genus and species. From those discussions the name *Tepakiphasma* was chosen as a fusion of ‘Te Pahi’, the location where the insect was collected, and ‘phasma’, from the Greek for ‘apparition’, which is commonly used in stick insect names globally. The species epithet “*ngatikuri*” was given in recognition of the then belief that this stick insect was restricted to the rohe of Ngāti Kuri. The full name therefore became *Tepakiphasma ngatikuri* (Buckley & Bradler 2010). Another stick insect recently described was a new species of *Clitarchus* from the Poor Knights Islands (Buckley et al. 2014). These islands are within the rohe of Ngātiwai who provided the specific epithet “*rakauwakanekeneke*”. This name is a fusion of the te reo words ‘rākau’ (stick), ‘whaka’ (to cause something to happen) and ‘nekeneke’ (move gradually).

#### Case study 3: Incorporating Māori histories for extinct species

Naming extinct species has its own set of challenges. The now extinct *Megadyptes* penguin had previously lived around the South Island coast prior to Polynesian settlement (Boessenkool

et al. 2009). This lost penguin species was hunted to extinction rapidly, and was named *Megadyptes waitaha*, after the Waitaha iwi, who occupied much of Te Wai Pounamu (South Island) after early Polynesian settlement. Waitaha were later displaced by Ngāti Māmoē, who in turn were later absorbed by marriage and conquest by Ngāi Tahu in the South Island. This name, developed in collaboration with Ngāi Tahu, recognises their cultural knowledge, and reflects the fact that the current iwi Ngāi Tahu did not cause the extinction of this species.

#### Case study 4: Ground beetles (*Carabidae*)

Recently, the endemic Aotearoa ground beetle genus *Mecodema* has been under revision, with previous descriptions of new species (Seldon & Leschen 2011; Seldon et al., 2012) being incorporated within the new revision of the North Island taxa (Seldon & Buckley 2019). In these revisions the authors wished to acknowledge iwi as partners in the science of naming species and to forge connections and increased understanding with iwi / imi and the general community. Lead author (DS) specifically supported iwi naming of these ground beetle species because of their closer, longer-term and spiritual relationship to these taonga.

This approach resulted in contributions by a number of hapū, especially in Northland. The late Saana Murray (Ngāti Kuri) provided the name (*Mecodema tenaki*) for Seldon and Leschen's (2011) revision of the *curvidens* species group, a new species found in Ngāti Kuri's rohe. More importantly, Saana provided the context around the epithet. This approach continued with Hori Parata (Ngātiwai), Rongo Benson and Haami Piripi (Te Rarawa), and Ngāti Manuhiri who all provided names for new species of *Mecodema*. In all instances, species names were derived from consultation with speakers of te reo, and where possible when a species' range fell entirely within the rohe of a single hapū that was specifically consulted. For all species epithets that are the names of specific people (e.g. *M. genesispotini*), there was a much more extensive consultation process with permission granted by the person honoured, or by their closest relative. However, with the publication of these names: *M. aoteanoho*, *M. haunoho*, *M. manaia*, *M. parataiko*, *M. ponaiti*, *M. tenaki*, and *M. kokoromatua* (Seldon et al., 2012), not all Māori consulted accepted the marrying of two or more languages in the genus and species names as being a positive outcome for te reo.

#### Eponymous naming (Naming a species after a person)

Although there is strong support for including Māori words in the naming of new species, eponymous naming is not universally supported by Māori (Papa 2012). In group interviews that Papa conducted, one participant noted, with respect to ancestors' names: "that was a name that belongs to them, they have recognition amongst their people and that is where their honour should lie, amongst their people" (Papa 2012). On the other hand, other Māori view eponymous naming and / or recognition of ancestors as an important way of re-establishing 'mana whenua'. For example, Ngāti Rehua bequeathed their ancestors name 'Rehua' to a koromiko, *Hebe pubescens* subsp. *rehuarum* endemic to Aotea / Great Barrier Island (Bayly et al. 2003). Immortalising a person or ancestor forever can bestow great honor; however, this needs to be undertaken with respectful dialogue with all those that may have an interest.

#### Notes on macrons

Te reo has five vowel sounds, but as in other Polynesian languages, vowels can either be short or long. Short vowels are written with 'plain' vowel letters (a, e, i, o, u), while long vowels are either written with a macron (tohutō) over the vowel (ā, ē, ī, ō, ū), or as double vowels (aa, ee, ii, oo, uu). While the use of tohutō over the vowel is recommended by the Māori Language Commission (Te Taura Whiri i te Reo Māori) and this has become a requirement for Government Departments and teachers of te reo to follow, it is a decision that not all iwi / imi agree with or chose to follow. The distinction between vowel sounds is important because different vowel sounds in otherwise identically spelled words can result in different meanings depending on the macrons used, for example, *kēkē* means 'armpit', *kekē* means 'creak', and *keke* means a 'loan', or a 'cake' (this last example being a transliteration from English).

In taxonomic nomenclature it is specifically forbidden to use diaeresis (macrons) (ICN, Article 60.7; ICZN, Article 27), however, the ICN does allow for the use of diacritical signs as an aid to pronunciation of names (Article 60.7). This contradictory decision is a source of some confusion to some code users, but does potentially make it permissible to use macrons. The vagaries of the code however may be interpreted and enforced differently by different taxonomic journal editors. Most species with root words featuring diaereses remove these for the taxonomic epithet, and this is generally enforced.

While the loss of macrons for taxonomic epithets may cause difficulties or ambiguities when incorporating te reo, it is a matter beyond Aotearoa to readily resolve, as the decisions on this are international and affect many other languages. As an interim measure we suggest that if you do choose an epithet where the root words contain macrons, the long vowel sound could be replaced by a double letter: with (ā, ē, ī, ō, ū) becoming (aa, ee, ii, oo, uu) respectively (as is done for letters like œ, ø, ö, and æ from various European languages), or alternatively, it could be left as a single letter, making sure this change doesn't alter the meaning significantly. Such a decision on spelling should be made in consultation with a Māori language expert from the region where the species is found as macrons may be iwi / imi / hapū specific.

#### Notes on Latinisation

There has been recent controversy regarding the Latinisation of Māori geographic names in taxonomy (Gardner 1998; Webb et al. 1999; Whaanga et al. 2013). Rhys Gardner in 1998 strongly supported the Latinisation of Māori place names, referring to the recommendation in ICN 60D. 1: "An epithet derived from a geographical name is preferably an adjective and usually takes the termination *-ensis*, *-(a)nus*, *-inus* or *-icus*". The alternative method (as stated earlier in Rec. 23 A) is to treat the epithet as a substantive, and place it in the genitive case, for example, *novae-zelandiae* "of New Zealand", *makarorae* "of Makarora". Webb et al. (1999) however strongly oppose this view, stating that these "Māori epithets should be regarded as nouns in apposition and not corrected to any adjectival or genitive form (RK Brummitt pers. comm.)." They go on to state that the ICBN [now the 'ICN'] recommendations, are not compulsory, only advisory and "that it would therefore be counter to the ICBN [ICN] to correct them as Gardner suggests." They back up their views by stating that the "Māori Language Commission, as a matter of policy, deplors the alteration of the Māori language through the addition of foreign language



elements, particularly when Māori place-names are used to name plant and animal species.”

When Webb et al. (1999) published their view, the matter of Latinisation was taken by one of us (PdL) to a number of te reo speaking tangata whenua (Māori people with historical claims to the land) working as Kaupapa Atawhai managers for the New Zealand Department of Conservation. Their view, best expressed by the late Rau Kapa, was that such decisions fell outside the ambit of Te Taura Whiri I te Reo Māori, and that the most appropriate course of action is to discuss the matter with the appropriate iwi / imi. Some iwi / imi might object to the idea of the Latinisation of te reo geographic names whereas others might see it as a sensible way to educate the global community by providing a distinction between a vernacular name and a geographic location. Thus, *Podocarpus totara* takes its species epithet from the widespread te reo name for that tree, whereas *Senecio repangae* has an epithet based on an island called ‘Repanga’ whose Latinisation to “*repangae*” enables taxonomists to see that this epithet is derived from a geographic rather than vernacular name. The key issue here is informed discussion about the ICN recommendation rather than enforcing one position. Across languages and cultures, most scientists have agreed on accepting Latinisation to aid communication. However, it is also important in our postcolonial context that Māori should be able to prevent the perceived desecration of te reo, if the amalgamation of te reo with other linguistic practices is seen as such.

One possible way suggested by iwi for attempting to keep the integrity of te reo whilst Latinising geographic names as epithets might be to use hyphens, thus “*pokohinuensis*” could become “*pokohinu-ensis*”. There are examples where a hyphen is used in plant names (e.g. *Parablechnum novae-zelandiae*, *Melicytus novae-zelandiae*, *Herpolirion novae-zelandiae*). Our interpretation of the ICZN is that it would currently not support this; however, the Botanical Congress Nomenclature Sessions would be an appropriate avenue to discuss such difficulties, with the next meeting currently scheduled for 2023.

## Recommendations

### So how should we go about creating a species name?

There are several useful guides published advising scientists on how to create a species name, (Brown 1954; Winston 1999), as well as work that examines broader issues around the process and history of species naming, the varied and interesting names scientists choose and what all of this says about scientists and society (Heard, in press).

We suggest that taxonomists working on species from Aotearoa should seriously consider their relationships with Māori, the ways te reo and ta re can be integrated into their work, and the ways that their relationships with iwi / imi can develop. Both taxonomists and Māori have deep and special relationships with the natural world. For Māori, mauri (life force) is the connection between the wairua (the inner self or soul) and all things seen and unseen. Taxonomists and Māori have a lot to learn from each other, and our connections to the natural world, the mauri, are best cultivated together. Tokenism in naming species with Māori words without consultation is considered by Māori to be inappropriate conduct and can be highly offensive should the wrong word be utilised.

Using a species name to commemorate a Māori person’s name must only be undertaken with after full dialogue with the person and their family. While a taxonomist may wish to

honour someone or a group, honour comes through respect and collaboration. We recommend taxonomists develop relationships with iwi / imi. There is no one rule that must be strictly followed regarding macrons, Latinisation, word choice, or whether a Māori person’s name, or a Māori place name could, or should be used. We recommend discussing these issues with iwi / imi in a collaborative process, allowing ako (reciprocal learning) to take place. This message of collaboration being key is the same across all sciences (e.g. genetic sequencing of native species as discussed in Collier-Robinson et al. 2019): there isn’t one rule to obey, there is a relationship that needs to be fostered and respected. Species epithets are destinations, and it is the journey and the relationships formed on the way that matter. As Dr Manuka Henare said at the University of Auckland: “To name something is the means of establishing a relationship, namely a whakapapa, between the person or group doing the naming and the thing named. It is the basis upon which connections are made, identity clarified and asserted, and mana over that thing is generated” (ICS Solutions 1985).

The process of taxonomic naming and description should not only be collaborative, it should be undertaken in the spirit of goodwill, and not for financial gain. While we agree that koha (a Māori custom involving reciprocal giving) may be appropriate when there is protracted discussion, koha is a much abused and misunderstood concept that encompasses multiple meanings i.e. koha may be a gift, present, offering, donation or contribution. Koha should not be seen as a strictly financial transaction between two or more parties. A trade system degenerating into ‘cash for Indigenous name’ or ‘taxonomic naming rights for financial reward’ would be abhorrent to both Māori and taxonomists. Because taxonomy is intensive in terms of time, effort and cost, and poorly supported by research agencies and government funding (Nelson et al. 2015), we endorse a mutual partnership between iwi / imi and taxonomists, one given strongly in the spirit of ‘ako’ where both parties learn together.

We also urge that thought be given to creating a novel permanent electronic repository where the taxonomic usage of te reo / ta re names as epithets would be held, or the modification of the NZOR catalogue to enable this. This database could then act as a resource for future taxonomic researchers, te reo / ta re speakers and students, Māori / Moriori and the people of Aotearoa in their studies. If such a database were to be created where the goal is to explain the etymology of newly erected names, and ideally resolve the meanings of historic usages, this would be a powerful tool to encourage a better understanding of the unique, beautiful way that te reo and ta re have been incorporated into celebrating the unique biodiversity of this country.

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## Supplementary material

Additional supporting information may be found in the supplementary material file for this article:

**Appendix S1.** List of taxa recorded with te reo / ta re epithets.

The New Zealand Journal of Ecology provides supporting information supplied by the authors where this may assist readers. Such materials are peer-reviewed and copy-edited but any issues relating to this information (other than missing files) should be addressed to the authors.