Mapping Māori knowledge from the past to inform marine management futures

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Abstracts

E aro whānui nei tēnei tuhinga ki ētahi rangahau i whakamahi i te mātauranga moana kia whakamōhiotia, kia hāpaitia hoki ngā tukanga rangahau ā-papa me ngā rūritanga o te pūtaiao Pākehā. I whakatau te mātauranga Māori ā-wāhi nei, ā-moana nei hoki, i te tikanga tuku me te tikanga ine i ngā taonga hirahira nei ki te ahurea Māori pēnei me; te Kina, te Koura, te Kūtai, te Pāua anō hoki, i ngā ākau i hī ngohi ai ngā whakareanga maha, i whakahaerehia rā hoki e rātou. Kātahi taua mātauranga ka whakamaheretia, ka whakamahia hoki hei taumata ine i ngā rūritanga rangahautanga ā-papa o te pūtaiao mō te takutai moana. Ko ngā kitenga i hua mai i te rangahau matarau mō te moana i whakamahia rā kia whanake ake ngā mahi whakahaerenga ki te hāpai i ngā umanga Māori me ngā umanga Kāwanatanga kia pai ake, kia tiketike ake, kia whakahaumarutia ake anō hoki ngā taonga a Tangaroa ā haere nei te wā. Ka āta wetewete, ka whakatauira hoki tēnei tuhinga i te whaipānga me te kōkiri tahitanga i waenga i te mātauranga Māori me te pūtaiao Pākehā, me te hiranga o ngā rautaki kaupapa Māori nei kia whakamanahia ai ko te mahi tahi me te Māori, ka tahi, ka rua ko tō te Māori reo i te whakawhanake takirua nei, i te whakatinanahanga, i ngā whakawhiti kōrero anō hoki i roto i ngā rangahau ā-moana.

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This article provides an overview of research which used mātauranga moana (Māori marine knowledge systems) to inform and assist Western science field research methods and surveys. Place-based Māori marine knowledge identified the traditional distribution range and sizing of taonga (culturally important) species in traditional coastal areas which had been fished and managed by consecutive generations of Māori; kina, Evechinus chloroticus*, sea urchin; koura,* Jasus edwardsii*, red rock lobster; kūtai,* Perna canaliculus*, green lipped mussel; and pāua,* Haliotis iris*, abalone. This knowledge was then mapped and used as the baseline for sub-tidal marine science field research surveys. Findings from the transdisciplinary marine research was used to develop management actions to assist Māori and Government entities for improving, enhancing and safeguarding marine taonga species into the future. This article critically discusses and demonstrates the relevance and complementarity of mātauranga Māori and Western science, and the importance of kaupapa Māori strategies for empowering Māori collaboration and voices in marine research co-development, implementation and communication.*

***Keywords**: mātauranga Māori, Western science, mapping, traditional knowledge, marine management, Māori knowledge systems, rohe moana.*

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Glossary

Mātauranga Māori, Māori knowledge systems;
Kina, *Evechinus chloroticus*, sea urchin;
Koura, *Jasus edwardsii*, red rock lobster;
Kūtai, *Perna canaliculus*, green lipped mussel;
Pāua, *Haliotis iris*, abalone;
Moana, marine environments;
Mātauranga moana, Māori marine knowledge systems;
Hapū, sub-tribe;
Iwi, tribe;
Taonga, culturally treasured/important;
Māori, Indigenous peoples of Aotearoa New Zealand;
Tangata whenua, people of the land;
Kaimoana, seafood;
Mahinga kai, harvesting areas;
Tikanga Māori, cultural practices;
Rohe moana, traditional oceanic territory of a coastal hapū/iwi.

Introduction

The ocean and its resources are of significant cultural importance and value to Māori. In pre-European times, the ocean provided coastal hapū and iwi with a key food resource, a means of transportation, cultural identity, and ecological connectivity (Ministry for the Environment 2010; Royal 2010; Brake & Peart 2013). However, for over one hundred and twenty years, a significant number of legislative Acts, policies, and plans actively enforced the exclusion of Māori from participating in management decisions and actions for their traditional territorial land and oceanic areas. Over time this resulted in traditional fisheries knowledge, activities, and decision-making capabilities being replaced by non-Māori fishing perspectives and practices (Hooper & Lynch 1999; Leach 2006). These actions severely interrupted the intergenerational transmission of ecological knowledge and marine management activities for taonga species and their associated ecosystems.

Today, many Māori entities have substantial concerns regarding the degeneration of marine species and spaces and want action to prevent further degradation and to allow recovery in multi-use ecosystems.

This article provides an overview of a research project conducted in 2009/2010 which used mātauranga Māori with western science to map the distribution and abundance of four taonga species at three traditional sites of significance in te rohe moana ō Ngāti Awa (traditional oceanic areas of Ngāti Awa). The information from the research was used to assist the development of a Ngāti Awa marine management plan and formal application to Fisheries New Zealand for the establishment of a mātaitai reserve under the Fisheries (Customary Kaimoana Fishing) Regulations 1998. Mātaitai are marine management tools which recognise and provide for traditional fishing through local management. They allow customary and recreational fishing but usually do not allow commercial fishing (NZ Legislation 2019). Mātaitai provide legislative ability for Māori to establish management regimes for their rohe moana, permitting recreational and customary fishing management practices while prohibiting commercial fishing activities.

Ngāti Awa Customary Fishing Authority

Situated in the Eastern Bay of Plenty region of Aotearoa New Zealand, Ngāti Awa are a coastal Māori iwi (tribal authority) made up of 22 hapū or subtribes. In 2005, a Deed of Settlement was signed between Ngāti Awa and the Crown (Ministry of Justice 2005) which resulted in the establishment of the Ngāti Awa Customary Fishing Authority (NACFA) in 2007. The NACFA encompasses the development of management actions and kaitiaki (tribal fisheries officers) for te rohe moana ō Ngāti Awa (Te Rūnanga ō Ngāti Awa 2009).

Overview

The purpose of the project was for Ngāti Awa to know the state of our rohe moana. Ngāti Awa had no ready access to resource information about the customary fisheries and the environmental and harvesting impacts upon marine resources within the rohe moana. The four identified taonga species (kina, kūtai, pāua, and koura) surveyed in this project were selected by the NACFA as the species considered most likely under stress due to a history of consistent harvesting pressure by commercial, recreational, and customary fisherpeople (O'Brien 2010). It was further suspected that exposure to environmental degradation of waterways through land runoff and pollution (Environment Bay of Plenty 2006) was also impacting the health of taonga species.

The three sites of significance were all located in the rohe moana and include the rocky shore coastline of Kohi Point to Ōtarawairere (hereafter Site A), the inshore island of Moutohorā (Whale Is.), (hereafter Site B) and the islets of Rūrima, Moutoki and Tokata jointly referred to as Rūrima (hereafter Site C). All three sites were geographically positioned within a maximum twelve nautical miles from the mouth of the Whakatāne river (Figure 1). The rohe moana also includes the soft-bottomed Ōhiwa harbour and the islands of Whakaari (White Is.) and Mōtītī. Both islands have overlapping historical interests with multiple neighbouring iwi. Motunau (Plate Is.) is a site of interest for Ngāti Awa, although it is understood that Motunau is under the full and direct management authority or mana moana of Ngāti Whakahemo, a kin relation to Ngāti Awa. The three rocky reef sites have been easily accessed and frequented by Ngāti Awa for the procurement of kaimoana over many consecutive generations.

The three sites were identified by the NACFA as having important cultural, spiritual, historical and environmental significance in the traditional fishing grounds of Ngāti Awa (Te Puni Kokiri 1996; Ministry of Justice 2005).

Mātauranga Māori

Mātauranga Māori or Māori knowledge and experiences of the natural world encompasses not only what is known but how it is known (Paul-Burke et al 2018), and the connection of inter-generational knowledge with the environments from which it is derived (Jackson et al 2018; Mercier 2018). Māori epistemologies or ways of knowing, being and doing, take for granted that all elements of the natural world are related, and it is upon those relationships that survival depends. This ideology suggests that the natural world is an intricate and intimate system, composed of many interacting and adaptive structures and components. All elements move and interact within a complex holistic framework of relationships both human and non-human, tangible and intangible, each supporting and benefiting the other (Rameka & Paul-Burke 2015).

Ngā tohu o te taiao (hereafter tohu), or the signs and symbols of the natural world, are often referred to as en-

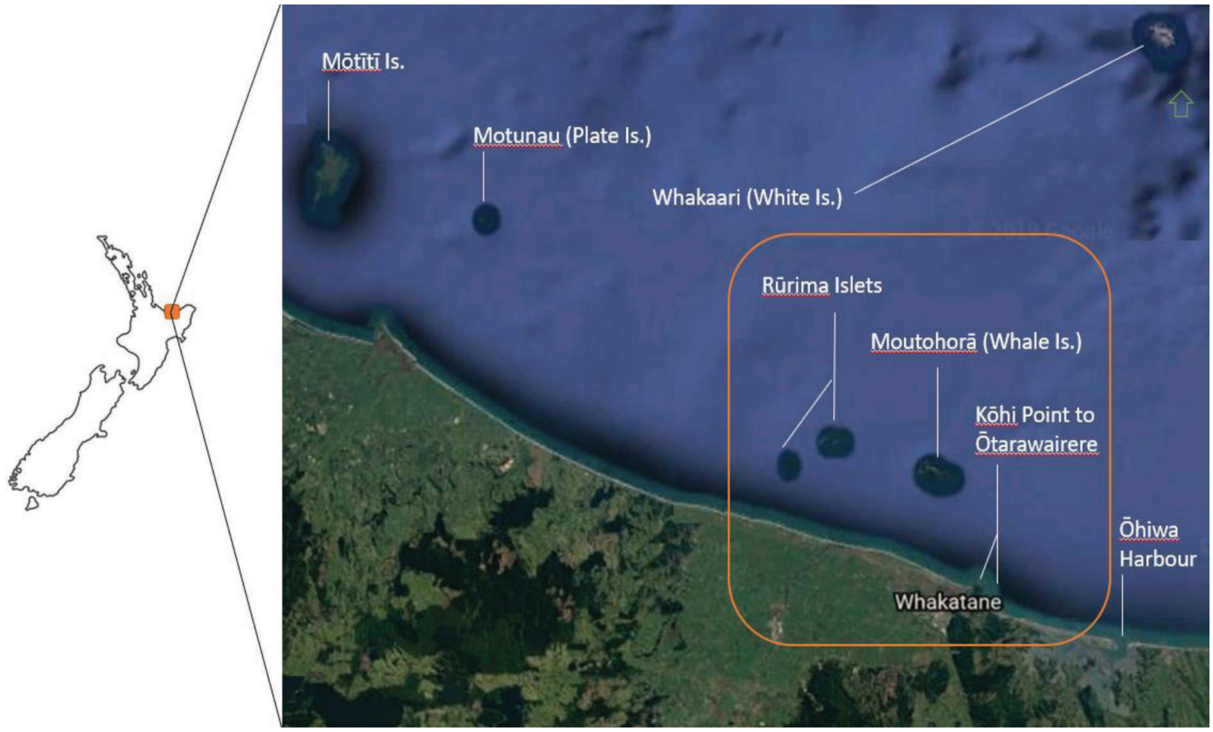

Figure 1. Map identifying traditional coastal islands and marine areas of interest for Ngāti Awa. Orange box identifies the sites that were surveyed as part of the mātauranga Māori and Western marine science field research project discussed in this article. Map Data @ Google, Imagery @2019 Google TerraMetrics.

vironmental indicators and are widely used by Māori environmental practitioners to identify trends or changes in the state or health of marine environments (Paul-Burke 2017). Tohu show if ecological systems are getting better or worse and recognise social/cultural/environmental declines and changes as precursors to ecological tipping points. Māori carefully scrutinised the natural world, they took special note of seasons, circumstances and habitual cycles. All forms of knowledge were directly or indirectly sourced from the environment. The act of observation and information gathering was integral to a range of established sustainable management practices that governed the harvesting, use and protection of natural resources (Kerr & Grace 2017). Attention was given to recognising, interpreting, and responding to tohu and the cumulative effects, causes and events associated with the natural world (Paul-Burke 2017). In time, this information became common knowledge and was conveyed from one generation to the next.

Individual hapū and iwi have their own localised understandings of tohu which are specific and relative to their environmental contexts, experiences, observations and understandings of species interactions and patterns of use. These accumulated intergenerational understandings, practices and knowledge transmission are grounded in the existence of Māori, who are intimately bound to residing in one place for many generations (Cheung 2008). Māori worldviews consider the wellbeing of natural resources to be directly related to the wellbeing of the people. Using mātauranga Māori to co-develop understandings of ecosystem stability, recoverability, and resilience across consecutive generations, including coordinated managerial approaches, is increasingly recognised as an important tool for contemporary marine management (Forster 2012; Lyver *et al* 2016).

Methodology

Kaupapa Māori research methodologies have arisen out of mātauranga Māori as a theory and analysis of the approaches to research which involve Māori (G. Smith 2009). It does not exclude a wide range of other methods but rather signals the interrogation of methods in relation to cultural sensitivity, cross-cultural reliability, and meaningful outcomes for Māori and their wider communities (Cram 2002; Pihama 2010). Kaupapa Māori is formative (Cunningham 1998) as it creates an awareness of another worldview. It legitimises Māori epistemology which is meaningful to Māori and seeks to empower and honour the research participants by ensuring that they have access to the research and ownership of their intellectual property, which helped shape and inform the research project (L. Smith 1999).

Kaupapa Māori research is positioned to address the concerns of Māori and in so doing provide a construct for informing the wider community (Mane 2009; Keer 2012). This can be achieved by actively including the participants in all stages and at all levels of the research design and implementation of the project, to ensure that their 'voice', perspectives, and knowledge were accurately represented and communicated in a language and cultural context that was appropriate, understandable, and made clear links to the research outcomes for Māori. Kaupapa Māori seeks to shift the traditional power dimension from the researcher to the researched. This position locates research which is grounded in the material existence or experiential reality of the participants (Freire 1970), for as Marx discerns, it is not the consciousness of men that determines their existence, but their social existence that determines their consciousness (Marx 1958).

Methods

The aim of the research was to gather traditional intergenerational knowledge alongside contemporary quantitative information regarding marine taonga species and sites of significance within te rohe moana ō Ngāti Awa to assist decision making for the NACFA. This was to be achieved by answering the following questions:

1. What/where are the traditional harvesting sites of kina, kūtai, koura, and pāua in te rohe moana ō Ngāti Awa?
2. What is the current distribution (location range), sizing (how big or small), and abundance (how many), of the four species at identified sites in te rohe moana ō Ngāti Awa?

The methods used in the study were in three stages. Stage one involved ethical approval and qualitative interviews, stage two involved a boat field trip with participating kaumātua (elders) and pūkenga (experts), and stage three involved quantitative dive surveys.

Stage one included semi structured, small-group focus interviews with kaumātua/pūkenga who are or have been active users of marine resources, and/or were identified as those most likely to have traditional ecological knowledge of customary species distribution patterns and/or socio-cultural knowledge of identified sites across time and space. The information shared by the participants was based on their experiential observations and knowledge accumulated over fifty or more years (Pauly 1995). Other ecological knowledge such as the depth range of harvesting (dive) sites, sizing, abundance estimates, coastal water, weather patterns, and habitat information was also discussed. Thirteen participants aged between 58 and 80+ years were interviewed for the project (O'Brien 2010).

Stage two involved a boat field trip to enable participants to physically identify the traditional distribution, abundance, and sizing of the marine species using inter-generational harvesting landmarks and ngā tohu o te taiao or Māori environmental indicators (Paul-Burke *et al*. 2010). The information was then recorded on the main research vessel using Global Positioning Satellite (GPS) coordinates as well as a Garmin 78sc handheld GPS system as a data backup precaution. Mapping traditional distribution areas affirmed mātauranga Māori as having value in its own right while also communicating and informing research and decision making for a variety of ecological systems (Lyver *et al*. 2016). Mapping the seascape through participatory research strengthens the management of marine resources through the use of local, place-based intergenerational knowledge and values within a system that integrates as equivalents, Indigenous and Western forms of knowledge (Aswani & Lauer 2006).

During the boat field trip, participants were asked to determine their start and end boundaries and/or specific spots of distribution for each of the four identified species. The information shared by participants was based on their experiential harvesting knowledge and practices as kaitiaki (environmental guardians) and food gatherers. This information was then substantiated by other participants when recounting conversations, observations, and practices of their people having harvested the same species from the same marine areas for many consecutive generations (Paul-Burke *et al*. 2018). To assist participants with recollections of sizing the identified species, different sized samples of the species had previously been gathered and placed in size class orders as a visual reference (Figure 2). Information from interviews and the boat field trip was used to determine the commencement of all Western science sub-tidal (underwater) dive mapping and surveying across the rohe moana. This approach actively positioned mātauranga Māori alongside other knowledge systems as a 'normal' approach to research (Mane 2009; Paul-Burke & Burke 2016).

The information obtained during the boat field trip was verified and approved by participants before being recorded using WGS84 marine GPS system for future replication monitoring surveys and for comparability purposes (MacDiarmid 2008). The GPS coordinates of the four identified species were then translated into visual representations using a free online mapping tool in cohesion with a satellite imagery tool. The combined mapping tools were selected to allow Ngāti Awa independent access to easy-to-use, accessible, and affordable mapping systems for any future monitoring or replication efforts.

Stage three included subtidal surveying of the identified marine taonga species. All surveys were commenced on the traditional start and end distribution boundaries identified by kaumātua/pūkenga. Surveying kina required research divers to swim along a 25 metre transect line placing a 1m^2 quadrat on every odd number along the transect. All kina within the quadrat were counted and measured (Freeman 2006 MacDiarmid 1994; Kayes 2009) (Figure 3). Kūtai were surveyed by placing a 1m^2 quadrat on the substrate, reef rock or pinnacle to take percentage assessments 0–100% in multiples of five. The sizes of five individuals in the top right-hand corner of the quadrat were then measured (Dytham 2003; MacDiarmid 2008; Morrison 1996). All measurements of kūtai were taken across the widest part of the shell as opposed to the industry measurement of farmed kūtai which utilised shell length. Measuring across the posterior (widest) end of the kūtai was used to inflict the least possible impact on the mussels (Paul-Burke 2007). This was consistent with baseline survey research studies undertaken by Paul-Burke (2007, 2008, 2009) on kūtai populations in Ōhiwa harbour. Kick cycles were used to determine quadrat placement and to provide an estimation of the sizing of the reef/rock pinnacle surveyed. Koura and pāua were surveyed using the 10-minute timed count method (McShane *et al*. 1994; Kingsford & MacDiarmid 1998). The count started from when the first koura or pāua was located. If it took one minute or more to locate the first koura/pāua the time was recorded, and the ten-minute time count then commenced. If no koura/pāua were found within the ten-minute timeframe a nil count was recorded. The diver then ascended to the surface. At the surface the position of the diver in correlation with traditional landmark bearings was recoded and geographical coordinates were marked by the research boat person using a handheld GPS (Paul-Burke *et al*. 2013). All koura located were measured along the carapace length (body cavity) (Kingsford & MacDiarmid 1998), using rulers marked with pre-determined size classes (Roberts 2007), if individuals were able to be caught without being damaged. However, if koura were unable to be caught, an estimate of the carapace

Figure 2. Images 1 & 6, participants identifying marine taonga species distribution, sizing and abundance at identified sites of significance during the boat field trip. Image 2, a rocky reef site in the rohe moana ō Ngāti Awa. Images 3 & 4, examples of species size classes used to assist sizing recollection during the boat field trip. Image 5, mapping workshop with participating kaumātua and pūkenga. (Images by Waka Paul and Tuwhakairiora O'Brien, 2010.)

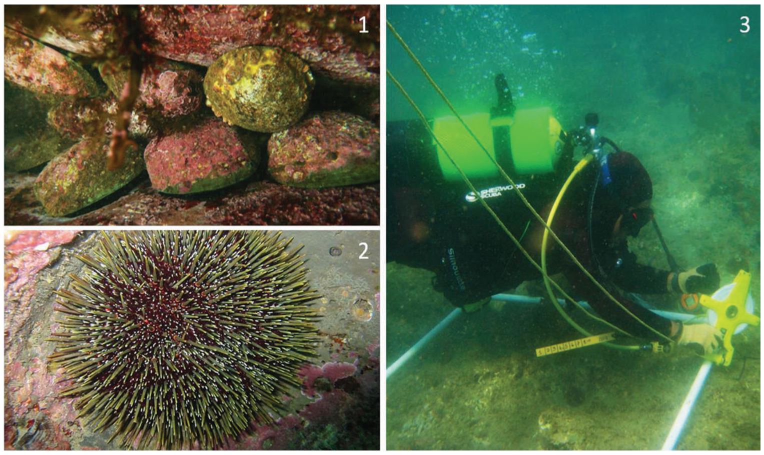

Figure 3. Images of (1) pāua; (2) kina and (3) Ngāti Awa researcher conducting dive surveys in te rohe moana ō Ngāti Awa.

was made (Kayes 2009; Kingsford & MacDiarmid 1998). Every pāua measured was carefully removed from the rock surface, measured along the length of the shell (Freeman 2006; Kingsford & MacDiarmid 1998) with a flat, blunt pāua iron and then placed back in its original position. If for any reason pāua were difficult to remove, they were left undisturbed and an estimated sizing was made. All species were measured in size classes. All survey dive locations were determined by the intergenerational mātauranga Māori identified by participating kaumātua/pūkenga.

Results

Part One – Mapping mātauranga Māori

Part one included the qualitative interviews/workshops and boat field trip, with participating kaumātua/pūkenga identifying intergenerational understandings of marine taonga species distribution, abundance, sizing, and customary fishing sites and harvesting practices within te rohe moana ō Ngāti Awa. The sharing of mātauranga Māori by the participants in support of the research project was imparted with serious and thoughtful reflection. Participants openly shared their ecological and cultural understandings of tohu and species lifecycles, relationships, habitats, and patterns of distribution. They also shared their 'secret' intergenerational whānau (family) fishing boundary parameters and harvesting spots with the researchers, trusting that their traditional experiential knowledge would 'truly' benefit the following generations and the natural world in which we live.

As a result, the researchers were left with an overwhelming sense of responsibility to get the research 'right' (Mead 2003) not only for future management of the rohe moana, but also the implicit sense of honouring the participants' wisdom, cultural guidance, and support for the research. Irwin (1994) postulates that kaupapa Māori research is about cultural safety undertaken by Māori researchers who are guided and/or mentored by kaumātua/pūkenga. This ensures that the research approach is both culturally relevant and appropriate, while at the same time satisfying the rigours of academic research (Bishop 2008, Forster 2012).

As two of the three researchers were also descendants of Ngāti Awa, it was automatically assumed that we would

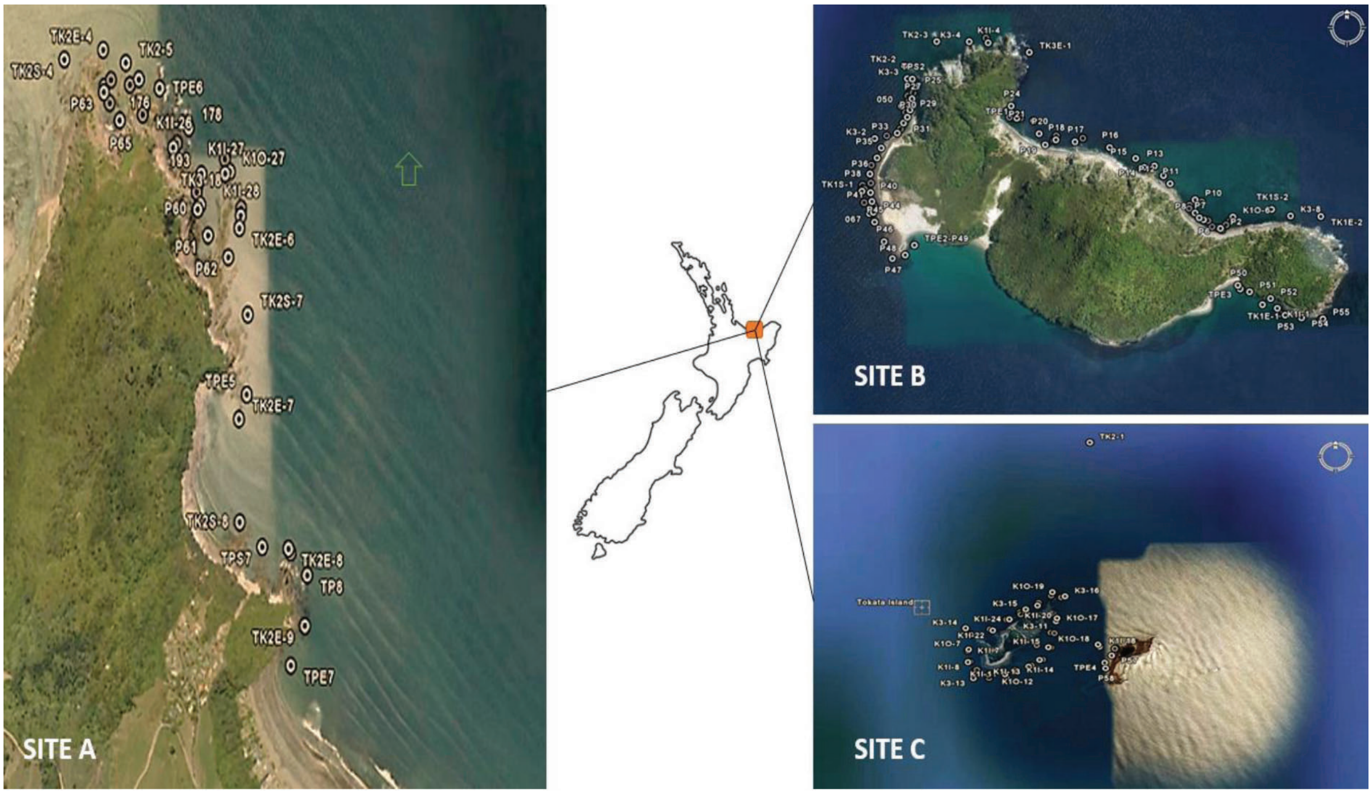

Figure 4. Public map of traditional and contemporary distribution of four identified marine taonga species in te rohe moana ō Ngāti Awa. Map Data @ Google, Imagery @2009 Google TerraMetrics.

'naturally' protect the knowledge imparted to us (L. Smith 1999). While kaumātua /pūkenga never once said 'don't tell anyone where my grandparents' dive spots are', it was an unspoken agreement that certain aspects of the knowledge shared were not intended for public consumption; and when the project ended, particular private dive 'spots' identified in the research would remain the private intergenerational dive spots of kaumātua/pūkenga and their whānau. The research study honoured that unspoken agreement.

From a Māori worldview it is understood that not all cultural knowledge is open or accessible to everyone (Mead 2012). To promote and protect intergenerational mātauranga Māori of traditional customary fisheries information, all GPS waypoint coordinates identifying the exact distribution locations of the four taonga species were omitted from public reports. All species traditional and actual distribution locations were coded. No legends explaining the codes were provided nor included in public maps (Figure 4), documents, reports, appendices, or power-point presentations. All information pertaining to kaumātua/pūkenga intergenerational 'private or secret' family dive spots were omitted from all documentation both public and private. This format is consistent for all distribution maps of all species surveyed. The GPS coordinates with exact dive site locations across all sites surveyed were provided to Ngāti Awa in a separate report, entitled: Private and Confidential Document Two: GPS Coordinates of Actual Taonga Species Distribution in the Rohe Moana ō Ngāti Awa (Paul-Burke *et al*. 2010). If external individuals wished to access the culturally sensitive knowledge, it is understood that they must make direct contact with the knowledge holders of Ngāti Awa.

Protecting the cultural and intellectual property of participating kaumātua/pūkenga is supported by Royal (2006, p. 25) when he asserts: 'like all bodies of knowledge of this kind, there are aspects that are common to the community and there are aspects which are held by specialists'. Smith (2012, p. 72) adds: 'Māori society valued knowledge highly, to such an extent that certain types of knowledge were entrusted to only a few members of the whānau... there were sanctions that ensured that it was protected, used appropriately and transmitted with accuracy'. The specialists in this research study are the participating kaumātua/pūkenga, and their knowledge shall remain with them.

Part two – Quantitative surveys

Sub-tidal baseline surveys of the identified customary species at each of the three sites of significance was undertaken between January and March 2010. Baseline surveys refer to the data collected to provide an indication of the present state of the species at each specific dive site (Kingsford & Battershill 1998.) All actual dive survey locations for this research study were determined from the findings of qualitative interviews and the boat field trip with kaumātua/ pūkenga. A combined total of two hundred and eleven (211) GPS dive survey marks were recorded, identifying the distribution of identified taonga species – kina, kūtai, koura, and pāua – across the three sites in the rohe moana (Figure 4).

Kina, *Evechinus chloroticus,* sea urchin: A total of 364 × 1 m^2 quadrats and 18 × 25 m transect lines for kina abundance counts and size measurements across all sites surveyed was recorded. The most frequently occurring measurements of kina diameter were recorded in size classes 50–69 mm and 70–89 mm. The largest kina diameter

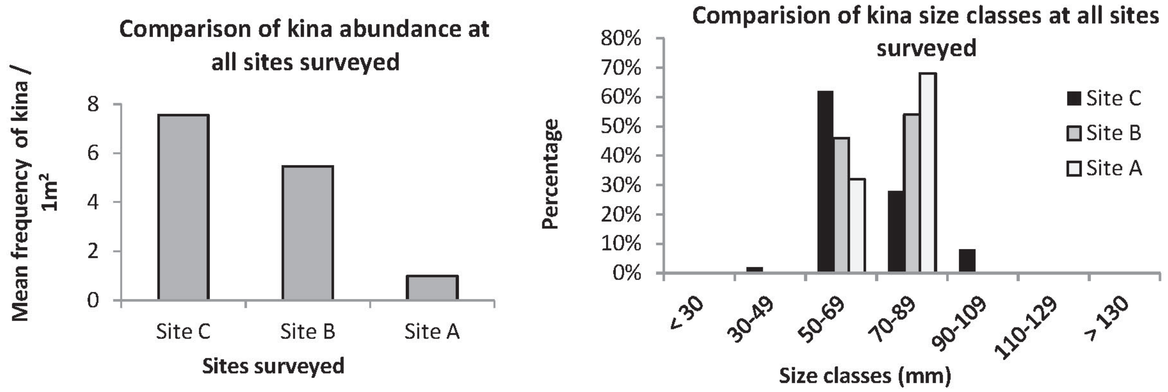

Figure 5. (L) Comparison of kina, *Evechinus chloroticus*, mean frequency /m² and (R) size classes (mm) measurements across all sites surveyed in te rohe moana ō Ngāti Awa 2009-2010.

measurements across all sites surveyed were found at site C, which also recorded the largest number of kina presence with a mean frequency of 8 per m^2 (Figure 5). This was consistent with the traditional intergenerational harvesting knowledge by kaumātua/pūkenga of kina abundance and sizing provided across all sites surveyed.

Kūtai, *Perna canaliculus,* green-lipped mussel: Kūtai percentage and sizing counts were achieved by using 283 × 1 m^2 quadrats. Consistent with kaumātua/pūkenga information, it was found that an important traditional intergenerational kūtai rock identified as being 'covered 100% with kūtai right down to the sand on the bottom' measured an estimated 64 m in circumference with 10% of the total area populated by kūtai. Site B recorded the greatest number of kūtai (51%) in size class 41–60 mm in width. Over all sites surveyed, site B recorded the widest range (four of the five pre-determined size classes were represented) and the largest kūtai measurements (Figure 6). The results of this survey found kūtai present at all three sites surveyed. However, in some areas of site A and site C the recorded measurements were substantially smaller than those recalled by kaumātua/pūkenga in the 1960s. Some areas of site A also recorded nil kūtai present. In site B it was found that kūtai sizes were significantly larger than previously estimated by kaumātua/pūkenga (Paul-Burke *et al*. 2010). Kaumātua/pūkenga identified site A and site C as traditionally the most preferred places for gathering kūtai due to their prolific abundance (O'Brien 2010). The results of the research suggested that a marked decrease in abundance of kūtai both in site A and site C may have occurred. A significant presence of the reef star, *Stichaster australis,* was observed at Site A.

Koura, *Jasus edwardsii,* red rock lobster: Across all sites surveyed 96 × 10 minute timed koura counts were conducted. The highest number for koura were found in a 'secret koura hole' identified by one kaumātua as the 'family heirloom'. Kaumātua/pūkenga recollections of where, when, how to dive, what landmarks and underwater features used to locate 'secret' sites were consistent with the findings and recorded the largest koura with an average 9 koura counted and measured every 10 minutes. The most consistently occurring measurement of koura across all three sites surveyed was recorded in size class 71–90 mm with site C recording 29% and 33% recorded in both sites B and A. The largest koura carapace length measurements across all sites surveyed were recorded in site C (figure 7).

Pāua, *Haliotis iris*, abalone. A total of 2524 individual pāua were counted and measured across all sites surveyed, of which 3 individuals were recorded in the legal take size of 125 mm or over. Participating kaumātua/ pūkenga had asserted that 99% of pāua were under the legal-size limit, with one site in te rohe moana known to have consistent legal sized pāua in small numbers. Their recollections were consistent with the quantitative findings. The greatest abundance of all pāua counted across all sites surveyed was recorded in Site B with site C recording consistently larger sized shell length measurements and the only site to record individuals in the legal harvest size of 125 mm or larger (Figure 8).

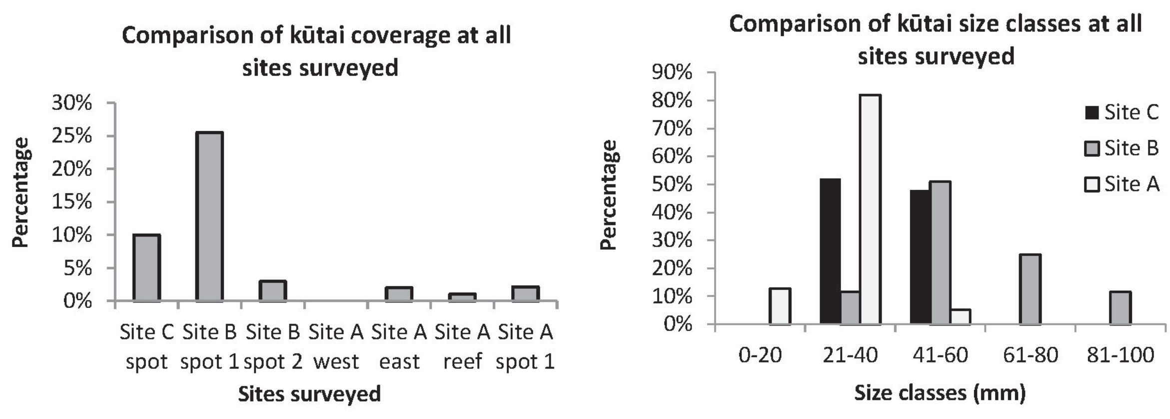

Figure 6. (L) Comparison of kūtai, *Perna canaliculus*, percentage coverage and (R) size class (mm) measurements across all sites surveyed in te rohe moana ō Ngāti Awa 2009–2010.

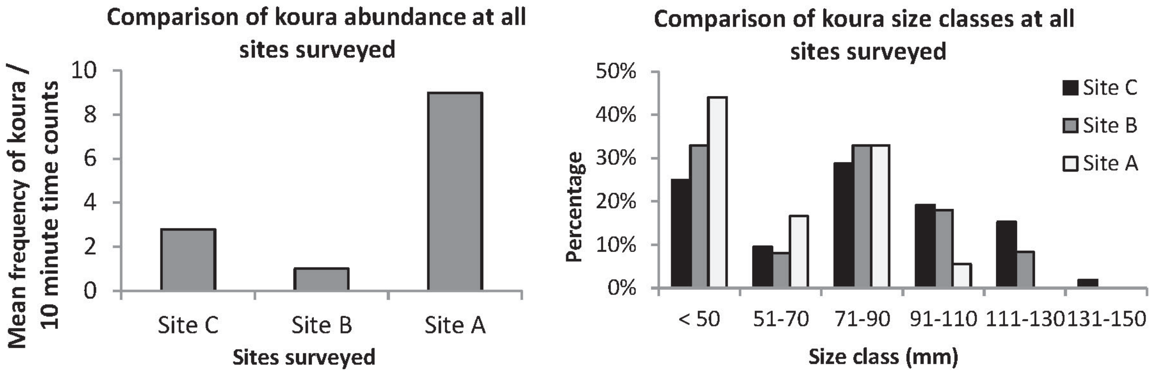

Figure 7. (L) Comparison of mean frequency of koura, *Jasus edwardsii,* and (R) comparison of size classes at all sites surveyed.

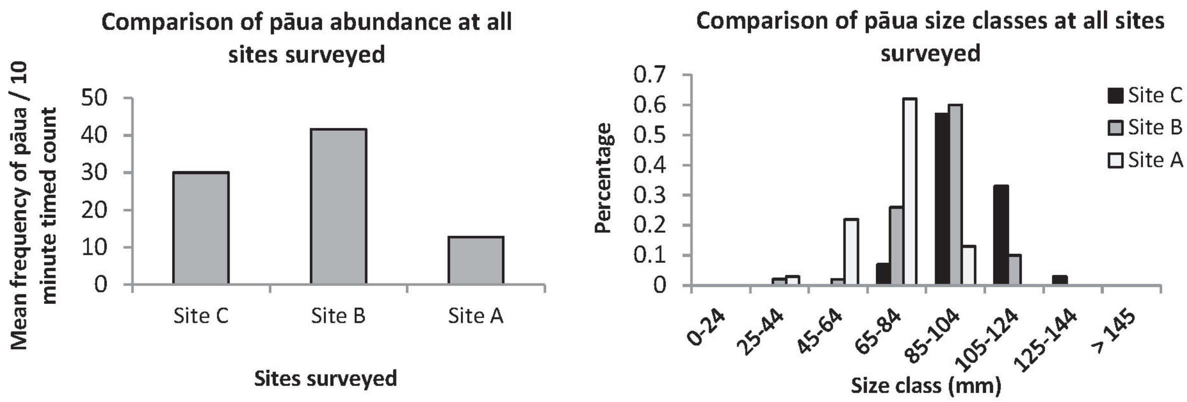

Figure 8. (L) Comparison of mean frequency of pāua, *Haliotis iris*, and (R) comparison of sizing (mm) width measurements across all sites surveyed.

Discussion and conclusion

In this study, mātauranga Māori was pivotal in identifying and determining all dive survey sites of the four marine taonga species within te rohe moana ō Ngāti Awa. With over two hundred mapped distribution GPS marks, it was found that all taonga species were located where kaumātua/pūkenga said they would be. Kaumātua/pūkenga knowledge regarding the sizing and abundance of taonga species in sites surveyed were consistent with the findings of the research, for example: kaumātua/pūkenga observations suggested that there were small pāua in large numbers in site B and the highest numbers of kina would be found in site C. This was also consistent with information pertaining to 'secret family' koura spots which was given with detailed intergenerational instructions such as location, depth, above and below water navigational marks, and tohu. Kaumātua/pūkenga observations also indicated that kūtai populations at site A and C had declined over the years (O'Brien 2010).

Positioning place-based mātauranga Māori alongside Western science to assist decision-making for marine taonga species and spaces helps mitigate issues of shifting baselines, in which each generation of scientists accepts as a baseline the stock size and species composition that occurred at the beginning of their careers and uses this to evaluate changes (Pauly 1995). The result is a gradual decreasing shift of the baseline, aggravated by the lack of personal, long-term intergenerational experience in localised marine spaces (Ray & McCormick-Ray 2014). This approach to marine management is supported by Butler (2006, p. 4):

> *We have reached a moment when fisheries managers are realising that their knowledge of the ocean resources is inadequate, and they are looking to resource users for information about particular resources. Practical knowledge is being recognised as a necessary supplement to scientific knowledge. Therefore, when we ask about a resource, we have to ask about the resource use – knowledge must be related to experience*.

This research arose from the needs, issues, aspirations, and priorities of Ngāti Awa. It employed a collaborative, transdisciplinary approach, with kaumātua/pūkenga and researchers to answer specific questions co-developed and designed by the NACFA. This included the collaboration of mātauranga Māori and Western science to better understand the state of taonga species in the rohe moana; and to assist decision making, promote recovery, and ensure a sustainable food basket for present and future generations. To that end, the findings from the mātauranga Māori mapping and quantitative field surveys were used to support an application to the Ministry of Fisheries for the establishment of a Mātaitai reserve in te rohe moana ō Ngāti Awa.

For coastal Māori there is a growing demand to investigate alternative ways of engaging with Western science to better understand degradation and assist recovery initiatives for culturally important species in marine environments. Māori aspire to live in sustainable communities with access to up-to-date evidence-based information to assist decision-making and marine management actions. Identifying ways in which hapū/iwi driven scholarship and place-based participatory practice can be captured and incorporated through co-developed transdisciplinary mapping tools to assist culturally important rohe moana, is a high priority. Research on ways in which mātauranga Māori can be captured, in accordance with tikanga Māori (culturally appropriate practices) and incorporated into marine monitoring, mapping, and management frameworks, is immensely important and would strengthen Aotearoa New Zealand's knowledge of the impacts of change on local ecosystems and communities (Ministry for the Environment & Statistics NZ 2019). Cultural diversity is related to biodiversity, and both may be important for improving the sustainability of the world's ecological systems for present and future generations (Berkes & Folkes 1994; WWF 2014; Diaz *et al*. 2019).

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