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RESEARCH ARTICLE



# Using Māori knowledge to assist understandings and management of shellfish populations in Ōhiwa harbour, Aotearoa New Zealand

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## ABSTRACT

This article discusses a marine research project which prioritised mātauranga Māori (Māori knowledge systems) to generate common management approaches and responses for the taonga (culturally important) species; Kūtai, *Perna canaliculus*, Green Lipped Mussel populations in Ōhiwa harbour, Aotearoa New Zealand. Findings from the trans-disciplinary marine research project were used to develop a mussel management action plan (MMAP) which was endorsed and accepted in its entirety by the high-level Māori tribal and Governmental partners of the Ōhiwa Harbour Implementation Forum (OHIF). This article provides an overview of research which used localised Māori knowledge systems to provide the foundations for improving, enhancing and safeguarding traditional mussel populations in the harbour. Further, this article critically positioned mātauranga Māori as an important and meaningful strategy for empowering Māori collaboration and voices in the wise use, care and practical management of marine taonga species for present and future generations.

**Glossary of Māori words:** Iwi: extended kinship group descended from a common ancestor, associated with a distinct region; Kaitiaki: guardian; Kaitiakitanga: active guardianship; Kaupapa Māori: Māori approach incorporating the knowledge, skills, perspectives and values of Māori societies; Kūtai or kuku: green lipped mussel (*Perna canaliculus*); Mahinga kai: food gathering/harvesting place and/or activity; Mahitahi: to work together, collaborate, cooperate; Manaakitanga: hospitality, generosity, the process of showing respect, generosity and care of others; Māori: Indigenous peoples of Aotearoa New Zealand; Mātauranga Māori: body of knowledge originating from Māori ancestors, including world views, perspectives and practices; Pātangaroa: eleven-armed seastar (*Coscinasterias muricata*); Rangatiratanga: autonomy, authority, leadership; Taonga: treasured; Tuakana/teina: refers to the relationship between an older or more experienced (tuakana) person and a younger or less experienced (teina) person; Whai-

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Ōhiwa harbour; green lipped mussels; Māori knowledge systems; mussel management action plan (MMAP); culturally important species

repo: eagleray (*Myliobatis tenuicaudatus*); Whanaungatanga: kinship, relationship through shared experiences and working together providing people with a sense of belonging

## Introduction

Kūtai or green-lipped mussels (*Perna canaliculus*) are an important traditional, inter-generational food source for coastal Māori. The mussels occur in dense beds, creating large reefs on soft bottom environments which increase diversity by providing habitat for a number of species; and food availability for predators such as pātangaroa (*Coscina nasterias muricata*, eleven-armed seastar) and whai-repo (*Myliobatis tenuicaudatus*, eagleray). As filter feeders, mussels help improve water clarity and quality by removing detritus from the water column, reduce re-suspension via pseudo-faeces deposits and improve reduced light availability (McLeod 2009; McLeod et al. 2012). Mussels also help control nitrogen from land derived sources (MacKenzie 2013). They are an important socio-cultural-ecological species and are considered a significant marine taonga for Māori.

In 2007, Māori tribal authority, Te Rūnanga o Ngāti Awa initiated and funded sub-tidal surveys of the mussel reefs in the western side of Ōhiwa harbour. It was found that an estimated one hundred and twelve (112) million mussels were present in the western side. Monitoring of the mussel beds identified a rapidly decreasing population with an estimated fifty-seven (57) million mussels in 2008, and sixteen (16) million mussels in 2009. In 2013 further monitoring identified an estimated two (2) million mussels remaining in the western side of the harbour with a significant 88% of the original 2007 mussel bed boundaries no longer present. In 2009, one point two (1.2) million seastars were also identified in the mussel beds in the western side of the harbour (Paul-Burke 2007, Paul-Burke and Burke 2013, 2016). Seastars are voracious predators of mussels (Paine 1966, 1971; Paine et al. 1985; Paul-Burke 2015; Wilcox 2017).

The research into Ōhiwa mussels has been limited to investigating only the western side of the harbour in an ad hoc and fragmented manner. For many years the people of Te Ūpokorehe iwi, have cited concerns for mussel populations in the eastern side, most notably in the Kutarere channel. However, in spite of Te Ūpokorehe concerns no evidence based information on the mussel populations in the eastern side of the harbour was available. The status of the beds was unknown.

This paper discusses the development of a mussel management action plan (MMAP) which sought to establish a harbour wide approach to assist understandings and decision-making for mussel populations across the whole of Ōhiwa harbour. Mātauranga Māori was considered not only fundamental to the collaborative development of the MMAP but also in providing a space for the voices of Māori and their roles as kaitiaki (guardians) for the once abundant but now severely reduced mussel reefs of Ōhiwa harbour.

## Ōhiwa harbour

Situated in the Eastern Bay of Plenty, Ōhiwa harbour is a 26.4 km<sup>2</sup> estuarine lagoon, is bordered by the 6 km Ōhope spit on the west and the 0.7 km spit on the east (Davies



**Figure 1.** Ōhiwa harbour (image by White Island tours n.d.)

1977; Richmond et al. 1984; Park 1991, 2005; Morrison 1996; Bay of Plenty Regional Council [BOPRC] 2013). The catchment area of the harbour begins approximately thirty-five kilometres inland and covers one hundred and seventy-one square kilometres (171 km<sup>2</sup>) (BOPRC 2014). It includes forestry, dairy/drystock farming, horticulture, residential living, and lifestyle blocks. In the upper catchment, approximately half of the land is in pasture, with the other half vegetated by indigenous and exotic forests.

The harbour lies within the ancestral homelands of Ngāti Awa (western side), Te Ūpokorehe (eastern side), Te Whakatōhea (north eastern side) and Tūhoe (Waimana Kaakū), (south-eastern side). Ōhiwa is steeped in the significant history of Māori who have lived and harvested from the harbour and its environments for centuries. For Māori, the harbour is an important mahinga kai (food gathering place) for shellfish and seafood (Morrison 2007). It is widely understood that Māori knowledge of the abundant food resources of Ōhiwa have endured for many generations (BOPRC 2008) (Figure 1).

Unfortunately, throughout the years increased harvesting pressures, seastar predation, sedimentation and other changing environmental conditions have taken its toll on the harbour (MacKenzie 2013; BOPRC 2014). In particular, the traditional mussel species have struggled to maintain its existence in the once abundant food basket of Ōhiwa. The need to actively implement mātauranga Māori derived resource management principles and practices to sustain mussel populations had become a priority for Māori.

## Mātauranga Māori

Mātauranga Māori can be described as a complex and dynamic knowledge system originating from Māori ancestors, which adapts and changes but does not lose its integrity

nor sense of origin. It encompasses not only what is known but how it is known and includes Māori world views, language, perspectives, principles, ethics and cultural practices (Paul-Burke 2016).

Individual hapū (sub-tribe) and iwi (tribe) have their own localised mātauranga which is specific and relative to their environmental contexts, experiences, observations and understandings of species interactions and patterns of use which have been accumulated and grounded in the existence of people who have resided in one place for many consecutive generations (Cheung 2008).

A Māori perspective of the natural world encompasses a biological-cultural (bio-cultural) perspective which positions humans within nature and focusses on ways in which cultural understandings and intergenerational connections between people and their biophysical context assist in the retention and protection of biodiversity and ecologically sustainable ecosystems (Paul-Burke 2016). Using mātauranga Māori to co-develop understandings of ecosystem stability, recoverability and resilience across consecutive generations, including cultural managerial approaches, is increasingly recognised as an important tool for contemporary resource management (Forster 2012; Lyver et al. 2016).

## Methodology

This project was positioned within a kaupapa Māori research paradigm, whereby the validity and legitimacy of Māori ways of knowing, being and doing is a given. Kaupapa Māori is a theory and analysis of the context of research which involves Māori, and of the approaches to research with, by and/or for Māori (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 useful outcomes for Māori (Cram 2002; Pihama 2010). Kaupapa Māori is a theory of change. It attempts to empower communities by using the past as a learning tool in conceptualising what Māori need to do to ensure that research practices and processes are respectful, ethical, truthful and transparent. Te Awakotuku (1991) constructed seven guiding principles for researchers to consider when working within a kaupapa Māori methodology. The guiding principles are relevant to this project and include;

1. Aroha ki te tangata – be respectful of yourself and others
2. Kanohi kitea – the seen face, present yourself in person
3. Titiro, whakarongo, kōrero – look, listen then speak
4. Manaaki ki te tangata – share the research space, host other ideas, be generous
5. Kia tūpato – be cautious
6. Kaua e takahia te mana o te tangata – do not trample over the mana or personal prestige of others
7. Kia mahaki – be humble, be open to other knowledge perspectives, the sharing of knowledges leads to shared understandings

Smith (1991) asserts ‘kaupapa Māori is the philosophy and practice of “being Māori.” It assumes taken for granted, social, political, historical, intellectual and cultural legitimacy of Māori people’ (p. 1). In this study a kaupapa Māori approach to research is foremost.

Kaupapa can be described to mean, ‘ground rules or the right way of doing things’ (Keer 2012). Kaupapa Māori then, is the right way of doing things Māori, with and by Māori.

## The Ōhiwa harbour strategy

The Ōhiwa Harbour Strategy 2014 is the cumulation of effort by Māori and Governmental partners of the Ōhiwa Harbour Implementation Forum (OHIF). The Strategy contains an action 2.1 to investigate shellfish populations and advocate for sustainable shellfish management. This action has led to the development of a mussel management action plan (MMAP) to build on investigations already carried out on the state of the mussel beds in Ōhiwa harbour (Te Tai 2016).

The OHIF is made up of elected members from Ōpotiki and Whakatāne District Councils, Bay of Plenty Regional Council, Ngāti Awa, Te Ūpokorehe, Te Whakatōhea and Waimana Kaakū. The high level OHIF is assisted by the Ōhiwa Harbour Strategy Coordination Group (OHSCG) which is responsible for overseeing the implementation of management actions in the harbour. The co-management structure is progressive and action-oriented.

## Co-designing the mussel management action plan (MMAP)

With strong support from the OHIF and OHSCG forums, the MMAP was co-designed with iwi partners and accepted in its entirety by the OHSCG for implementation into the harbour. The MMAP was grounded by localised mātauranga Māori and the principle of whanaungatanga (relationships); and sought to advance an inclusive harbour wide monitoring approach to assist management understandings of contemporary mussel populations in the harbour.

The notion of whanaungatanga as a research approach (Kennedy and Cram 2010) builds on from Te Awekotuku (1991) guiding principles of research and was fundamental to the development of the MMAP. In the context of this study whanaungatanga can be described as the acknowledgement of responsive, respectful, kinship ties and relationships through shared experiences and working together; providing people with a sense of collective belonging and a sense of responsibility to the kaupapa or task at hand. The principles of whanaungatanga (adapted from Kennedy and Cram 2010) include (Table 1).

Throughout the course of this project all mātauranga information and field research methods were co-managed, co-developed, approved and where possible co-implemented by iwi members. Consistent with and in adherence to the principles of whanaungatanga

**Table 1.** Principles of whanaungatanga.

PRINCIPLES OF WHANAUNGATANGA	EXPLANATION
Kotahitanga	The concept of mahi tahi or working together to achieve a common goal.
Manaakitanga	Highlights the responsibility to act, at all times, in a manner that uplifts and enhances the mana or personal prestige of others.
Kaitiakitanga	Encompasses the tuakana/teina or cross-disciplinary/cross-generational reciprocal sharing of experiences and knowledge.
Rangatiratanga	Promotes the strategic coordination and affirmation by contributing to collective decision-making.



and Te Awēkotuku (1991), at the beginning of each stage of the project, researchers met with iwi members to discuss and problem pose understandings, issues, aspirations, needs, priorities and potential actions for the taonga shellfish species and the harbour. Although iwi members were involved intimately throughout each stage, researchers always returned and reported back all findings, discussion and recommendations from the field research activities before progressing the process to the next stage. Iwi members positioned, prioritised and enabled (Mane 2009) the research to emerge from within their communities. They were directly involved in conceptualising the research focus and the subsequent development and implementation at all levels and all stages (Johnston and Pratt 2003).

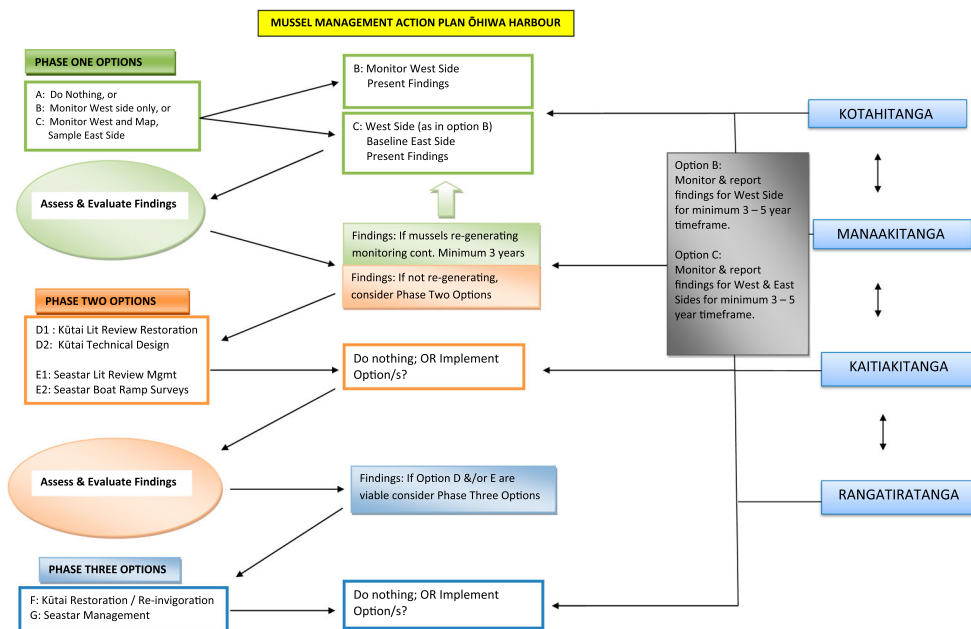
The process strengthened relationships and continued to evolve over many workshops and meetings. Throughout the research study the overarching principle of whanaungatanga emerged as the grounding force of the project, whereby the 'processes, procedures and consultation needed to be correct so that in the end everyone who is connected with the research project is enriched, enlightened and glad to have been a part of it' (Mead 2003, 318). The intent for developing the MMAP was to support knowledge management, sharing and decision-making capabilities of Māori and Governmental representatives in an accessible, easy to understand, collaborative and culturally appropriate manner (Sarka 2014).

## The MMAP

The purpose of the MMAP was to provide a practical action-based roadmap to assist decision-making capabilities for the harbour wide monitoring and restoration of mussel populations in Ōhiwa harbour. Consistent with the principle of kotahitanga and working together, the MMAP was collaboratively designed, in three phases.

**Phase One** of the MMAP sought to establish a mussel monitoring regime. This was to be achieved by conducting baseline surveys of mussels in the eastern side which would then enable the establishment of a monitoring regime of all mussel populations in all areas of the harbour (Paul-Burke and Burke 2016). To achieve this, Phase One of the MMAP offered three options for Māori and Government decision-makers of the OHIF. The first option was to do nothing. The second option was to establish a monitoring programme for the western side of the harbour only. The third option was to monitor the western side of the harbour and at the same time establish new baseline research survey action in the eastern side of the harbour. If the results of sampling efforts in the western side of the harbour identified a reinvigorated population of mussels, the decision-makers could decide to either proceed to Phase Two or stay with a three-year monitoring cycle of mussel populations in all areas of the harbour (options B and C, black box in MMAP, Figure 2). Consistent with the principle of rangatiratanga, the MMAP options promoted strategic collaborative coordination and allowed for flexibility and consideration of unforeseen circumstances such as resourcing limitations, re-structuring of forum priorities and ecological change (Kay 2008).

**Phase Two** options of the MMAP sought to collate information about how best to utilise mātauranga Māori and other knowledge systems to restore mussel populations in the harbour. If the mussel populations were not rejuvenating then the following options were available for decision-makers consideration. Option D1 sought to gather information on restoration efforts of mussels and other large bivalve species in temperate



**Figure 2.** Mussel management action plan (MMAP) for Ōhiwa harbour underpinned by the principles of kotahitanga, manaakitanga, kaitiakitanga and rangatiratanga. Kūtai; mussel.

estuarine environments. Option D2 sought to collate information of potential in-water methods and apparatus that may assist mussel restoration efforts in the harbour (McLeod et al. 2012).

Option E1 sought to access global information on management strategies of seastar populations, the rates of success, resourcing efforts and limiting factors (Te Tai 2016). Option E2 required boat ramp surveys be undertaken to ascertain the numbers and types of fish recreational and customary fishers were harvesting from the harbour (Hartill et al. 2015). Iwi observations over the years, had noted large numbers of fish being taken from the harbour, most notably in the busy summer holiday periods. The surveys were to target fisher-people on boats, the shore and wharves. The intention of the surveys was to understand if predators of seastars were being over-harvested by recreational and customary fisher-people (Paul-Burke and Burke 2013).

**Phase Three** options were positioned to action relevant information from phase two of the MMAP. Phase three provided decision-makers with considerations for evidence-based, pro-active strategies for the restoration of mussel populations and management strategies of seastars in Ōhiwa harbour.

To assist science communication, consultation, decision-making processes; and consistent with the principles of manaakitanga and kaitiakitanga; a series of reports and presentations were made to the management forums of the OHIF, OHSCG; regional iwi fisheries forum; hapū, iwi, local non-governmental organisations, schools, businesses and community groups of Ōhiwa harbour over a sustained two-year period.

The aim of the presentations and reports was to disseminate pertinent evidence based information and Māori ecological knowledge from marine monitoring surveys conducted in the harbour (Paul-Burke and Burke 2016); understandings and practices of shellfish



restoration (McLeod et al. 2012, 2014; MacKenzie 2013) and national and international seastar management approaches (Te Tai 2016). The second aim sought to capture the attention and commitment of the differing stakeholders to support the implementation of the MMAP, and in so doing, support the marine management efforts and aspirations of Māori (Forster 2012).

The mussel management action plan was presented to the Māori and government partners of the OHIF. The MMAP was unanimously accepted and endorsed by the partners. The OHIF forum members considered the recommendations for further research were crucial to address the issues and gain better understandings of the harbour's biodiversity.

The accepted recommendations included:

- Requests that the Ōhiwa Harbour Strategy Coordination Group (OHSCG) implement an assessment of the western side of the harbour, establishes a consistent and sustained monitoring programme to identify the cyclic patterns of mussel and seastar populations.
- Requests an assessment of the eastern side of the harbour to identify traditional and current mussel distribution areas, maps the bed boundaries and samples mussel populations consistent with the western side following which a monitoring programme is established.
- Requests a review be undertaken to determine best practice seastar management and rates of success in other locations (nationally and internationally).
- Request Ōhiwa Harbour Strategy Coordination Group to raise with their organisation the opportunity for funding to prioritise mussel and seastar research.

The cumulative efforts of the two-year science communication campaign; active and unwavering ethos of iwi kaitiaki; OHIF and OHSCG members resulted in strong community information and support for the harbour wide management of shellfish (mussels) into the non-statutory Ōhiwa Harbour Strategy Refreshed 2014 – as the number one priority management action for the harbour.

## Results

### *Implementing the MMAP*

Phase one of the MMAP was implemented in two parts. Part one included qualitative mātauranga Māori interviews of traditional mussel information in the eastern side of the harbour. Part two was informed by part one and involved quantitative marine field research (abundance, sizing, distribution mapping) of mussel and seastar populations in the western and eastern sides of the harbour (whole harbour approach).

### *Part One – qualitative implementation*

Part one involved two stages. Stage one included multiple hui held at Kutarere marae in the eastern side of the harbour, with Te Ūpokorehe resource management team. The purpose of all hui was to co-develop and determine research issues, priorities, ethics and tikanga for mussel populations in the eastern side of the harbour. Stage two involved a boat field trip for iwi members to physically identify traditional mussel distribution boundaries using inter-generational harvesting landmarks and environmental cues in

the eastern side of the harbour (Paul-Burke et al. 2010). Iwi participants identified three (3) traditional mussel distribution areas in the eastern side of the harbour. The most northern, southern, eastern and western boundaries of the traditional beds were then marked, under close direction of iwi participants, using GPS coordinates to correspond with GIS visual mapping tools. The mapping of traditional areas was important as Lyver et al. (2008, 99) asserts 'recording traditional knowledge holds value in its own right but can also inform research and management for a variety of ecological systems.' Aswani and Lauer (2006) add 'mapping the seascape through participatory research has allowed for the management of resources through the use of local ecological knowledge and values within a system that integrates as equivalents, indigenous and western forms of knowledge' (p. 82).

The intent of stage one was to position localised, inter-generational, Māori knowledge as the baseline and premise by which all scientific dive survey locations for mussels in the eastern side of the harbour were identified and determined. This worldview actively positioned Māori knowledge alongside other knowledge systems as a 'normal' approach to research (Mane 2009; Paul-Burke and Burke 2016).

During the boat trip iwi participants were asked to determine their start and end boundaries and/or specific spots of traditional mussel distribution areas. The information shared by iwi members was based on their experiential harvesting observations and knowledge accumulated over fifty or more years, which they substantiated by recounting conversations, observations and practices of their people having harvested from the same harbour for consecutive generations (Pauly 1995; Cheung 2008). This method was consistent with marine research practices conducted with Ngāti Awa in the western side of the harbour in 2007 (Paul-Burke 2007).

### ***Part two – quantitative implementation***

Sub-tidal dive surveys focusing on mussel and seastar abundance, sizing and distribution were conducted in the eastern and western sides of Ōhiwa harbour between the months of April-August 2016. Localised mātauranga Māori information of mussel populations identified by Te Ūpokorehe in 2016 and Ngāti Awa in 2007 determined the commencement of all sub-tidal (underwater dive) mapping, monitoring and surveying across the harbour. Iwi members participated with the sub-tidal dive surveys by remaining on the boat and assisting with identification and measurement of seastars, correlating traditional mussel distribution landmarks with GPS coordinates and identifying traditional dive site locations as per part one of the MMAP (Figure 3).

The findings of the sub-tidal surveys found that two (2) of the three (3) traditional mussel beds in the eastern side of the harbour were no longer present. The remaining bed presented mussels as patchy and in small clusters of approximately two-ten individuals per cluster. Mussel abundance counts identified an estimated fifty-nine thousand (59,000) mussels in the eastern side of the harbour.

In the western side of the harbour an estimated one hundred and twelve (112) million mussels were identified in 2007. In 2016 an estimated four hundred and eighty-five (485,000) thousand mussels were present. In August 2016, abundance counts identified an estimated five hundred and forty-four thousand (544,000) mussels in the Ōhiwa harbour. Approximately four thousand, seven hundred (4700) seastars were present in



**Figure 3.** Photographs (top left, right, and bottom left) of iwi members in all stages of the MMAP development and implementation. Photograph (bottom right) green-lipped mussels with eleven-armed seastar in Ōhiwa harbour.

the western mussel beds with zero (0) seastars in the eastern mussel bed. Recommendations that arose from the quantitative findings of the research included; (1) continued monitoring of all mussel populations in the harbour; (2) development of a seastar management plan and; (3) development and implementation of a practical in-water design for the restoration of mussel populations inclusive of localised mātauranga Māori in Ōhiwa harbour (Table 2).

In the western side of the harbour, mussels were observed as barely visible with many entirely covered by silt (Figure 4). In some instances’ research divers had to wipe away the silt so as to be able to correctly identify the mussels. In the eastern side of the harbour a

**Table 2.** Abundance of mussels and seastars.

Year surveyed	Mussel abundance Western side	Eleven-armed seastar abundance in mussel bed Western side	Mussel abundance Eastern side	Eleven-armed seastar abundance in mussel bed Eastern side
2007	112 million			
2008	56 million			
2009	16 million	1.2 million		
2013	2 million	98,000		
2016	485,000	4,700	59,000	0 in mussel bed 100,000 in pipi bed



**Figure 4.** (L) Covered mussels in the western side of the harbour; (R) seastars in the pipi bed on the eastern side of the harbour.

large presence of pipi (*Paphies australis*) were observed in an area close to where a former traditional mussel bed once resided. The pipi bed covered approximately two hectares (2 ha) with an average of five (5) seastars to every 1 m<sup>2</sup> or, an estimated one hundred thousand (100,000) eleven-armed seastars in the pipi bed.

### **Phases two and three of the MMAP**

Phase two of the MMAP has been completed (Paul-Burke and Burke 2016; Te Tai 2016). A practical in-water, collaborative design for a trial restoration of mussels in Ōhiwa harbour has been approved by the OHSCG. The trial restoration project combines localised mātauranga Māori with bio-physical methods and was in process at the writing of this paper. However, it is understood that seastar predation, sedimentation and other connected and multifaceted issues within the harbour remain unresolved, uncertain and complex (Thrush et al. 2016).

### **Discussion and conclusion**

Designing and implementing the MMAP was an expression of contemporary kaitiakitanga. The institution of kaitiaki(tanga) is part of a complex social, cultural, economic and spiritual system that has long been established through generational tribal associations and activities with land and waters (Minhinnick 1989). The practice of kaitiakitanga is commonly associated with an act of preserving, conserving and/or keeping watch over the natural world and (Marsden and Henare 1992; Marsden 2003) protecting the mauri or life sustaining capacity of its resources (Jackson et al. 2017) and in so doing, obliging each generation to pass onto their descendants at least as good a supply of resources as they, themselves, had inherited (Forster 2012).

Kaitiaki are human agents that are charged with the responsibility to safeguard and manage natural resources for present and future generations (Iwi Hapu Working Party



2005; Jollands and Harmsworth 2007). Decisions enacted by kaitiaki are based on the intergenerational observations and experiential understandings of mātauranga Māori. This process ensures the active engagement and retention of bio-cultural information and ecological management practices into the future (Paul-Burke and Rameka 2015). Kaitiaki relationships with the natural world are a fundamental expression of mātauranga Māori – of culture and identity (Waitangi Tribunal 2011).

Green-lipped mussels are an endemic species of Aotearoa New Zealand, ecologically important ecosystem engineers of soft-bottom estuarine environments (McLeod 2009) and a culturally significant species for Māori (BOPRC 2014). The decline of mussel populations in the harbour requires urgent attention because the consequences extend beyond their own decline to affecting the rest of the harbours ecosystem (Coleman and Williams 2002). The role of mussels in the structure and function of estuarine ecosystems has immense implications for marine biodiversity and management (Crain and Bertness 2006).

The purpose of the MMAP was to shift the focus of research efforts for mussel populations from the confines of the western side to all areas of the harbour, namely the western and eastern sides. Co-designing and co-implementing the MMAP in response to iwi voices was a meaningful step towards developing clearer understandings of changes that were occurring in the harbour and how best to manage those changes. The structuring of the MMAP assisted researchers to work in collaboration with decision-makers at all levels, problem posing and identifying each phase of the research design together, throughout all stages of the project. This process was important to iwi as it enforced co-development and transparency, providing greater cohesion of management strategies for mussel populations and their associated environments.

Utilising mātauranga Māori principles and processes to assist understandings and decision making for marine taonga species across consecutive generations, was an important tool for Māori, the OHIF and OHSCG forums. This approach provided a wider, more inclusive range of knowledges and practices, with which to activate an empowering and collaborative strategy in the wise use, care and practical management of culturally and ecologically important mussel populations in all areas of Ōhiwa harbour.

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