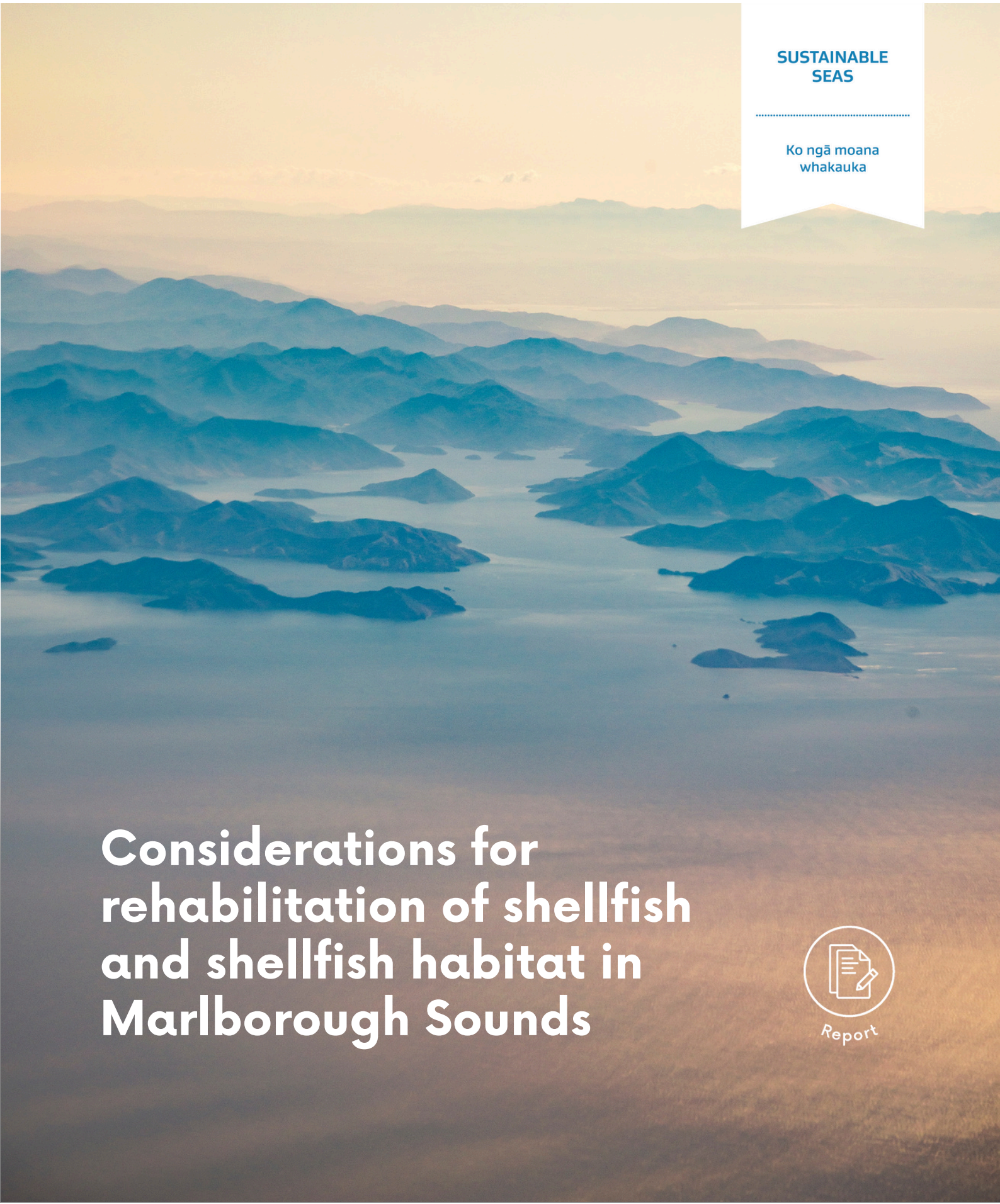
National SCIENCE Challenges

SUSTAINABLE SEAS

Ko ngā moana whakauka



Considerations for rehabilitation of shellfish and shellfish habitat in Marlborough Sounds

Report

Report prepared for Sustainable Seas National Science Challenge.

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About the Sustainable Seas National Science Challenge

Our vision is for Aotearoa New Zealand to have healthy marine ecosystems that provide value for all New Zealanders. We have 75 research projects that bring together around 250 scientists, social scientists, economists, and experts in mātauranga Māori and policy from across Aotearoa New Zealand. We are one of 11 National Science Challenges, funded by the Ministry of Business, Innovation & Employment.

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Central to thriving coastal marine communities in Aotearoa New Zealand are shellfish, which are valued as kaimoana and as essential components of a healthy ecosystem. As the health, structure and function of many of our coastal ecosystems have declined or changed, so too have some of the once plentiful shellfish beds.

This document provides an Aotearoa New Zealand perspective and overview of the importance of shellfish to healthy marine ecosystems, and the pressures that threaten them. It also describes the potential process and wider considerations for initiating restoration/rehabilitation activities, including cultural perspectives, setting and agreeing on goals, risk and benefits, evaluating success and legal considerations.

Shellfish are an essential group of organisms in our marine environment. The organisms themselves, and the habitats they create, provide many ecosystem functions, including water filtration, nutrient and chemical recycling, sediment stabilisation, biodiversity enhancement, habitat complexity, and food provision. These in turn provide direct benefits to humans - ecosystem services - including water quality improvement, carbon sequestration and denitrification, coastal protection, and fisheries enhancement. They are also of cultural and economic significance.

Despite the benefits of shellfish to the marine environment and the ecosystem services they provide to humans, many stressors (e.g. harvesting, seafloor disturbance, climate change, pollution, nutrients, sediments, invasive species and disease) can negatively impact them. The level of impact varies, ranging from reducing future resiliency to complete degradation of their habitat. The impacts from multiple stressors, at once or over time, can accumulate to cause greater impact and acts to reduce resilience of shellfish to future stressors.

There is increasing interest to improve, restore, and rehabilitate shellfish populations and habitats and the ecosystem services they provide. Restoration aims to assist an ecosystem in its recovery back to a pre-degraded state, while rehabilitation aims to recover and re-establish the ecosystem functionality.

Rehabilitation initiatives need to include and consider a clear purpose and vision, the need for cultural perspectives, and the importance of effective and inclusive ecosystem-based management, to facilitate longer-term success and persistence of any rehabilitation activities.

The process for developing and conducting shellfish/shellfish habitat rehabilitation should include: (i) ensuring there is broad engagement, including with community, tangata whenua and stakeholders, to incorporate the needs and concerns of multiple people; (ii) working together to define and agree on the issue to be addressed and the goals of the activities; (ii) learn from and build on existing knowledge and other rehabilitation initiatives; (iii) consider the feasibility, effectiveness, risks and benefits of the activities required; (iv) consider the ecological requirements of the species of interest; (v) evaluating success; and (vi) understanding the legislative requirements for any proposed activities. Throughout, we provide practical examples, from Marlborough Sounds.

We envisage that this will be a living document that can guide interested parties in establishing their own successful projects.

1 The aim of this document

Central to thriving coastal marine communities in Aotearoa New Zealand are shellfish, which are valued as kaimoana and as essential components of a healthy ecosystem. As the health, structure and function of many of our coastal ecosystems have declined or changed, so too have some of the once plentiful shellfish beds. There are many instances and growing examples of communities and groups coming together to improve health of marine ecosystems through rehabilitation or restoration (defined in Box 1), by minimising impacts of land- or marine- use on coastal environments, or actively enhancing shellfish beds. These range from large scale coordinated initiatives to local scale community activities. In this document we provide an Aotearoa New Zealand centred perspective and overview of the importance of shellfish to healthy marine ecosystems, and the pressures that threaten them. We then describe the potential process and wider considerations for initiating rehabilitation activities, including cultural perspectives, setting and agreeing on goals, risk and benefits, evaluating success and legal considerations. We envisage that this will be a living document that can guide interested parties in establishing their own successful projects.

Box 1. Defining ecological terms associated with restoration or rehabilitation.

- **Ecosystem restoration** aims to assist an ecosystem in the recovery back to a pre-degraded, damaged, or destroyed state.
- **Ecosystem rehabilitation** aims to recover and re-establish the ecosystem functionality when full ecosystem restoration may not be able to occur.
- **Ecological damage** occurs when a short but obvious negative impact occurs to an ecosystem (e.g., a storm event deposits sediment and destroys part of a shellfish bed).
- **Ecological degradation** occurs when a chronic or reoccurring negative impact results in ecosystem change, including a loss in biodiversity (e.g., ongoing pollution with excess nutrients causing turbidity and a loss of macroalgae).
- **Ecological destruction** occurs when the physical environment is ruined (e.g., dredging).
- **Ecosystem recovery** is when an ecosystem bounces back after ecological damage, degradation, or destruction has occurred.
- **Habitat creation** is an intervention, under the category of active restoration, that generates a habitat that was not part of the ecosystem historically (e.g., an artificial reef structure).

2 Setting the scene

2.1 Importance of shellfish to healthy marine habitats

Shellfish are an essential group of organisms that provide many important benefits to the marine environment. Shellfish are often called 'foundation species' or 'ecosystem engineers' in marine systems as they modify their habitat such that it becomes more (or less) suitable for other species to live within. In soft-sediment systems especially, shellfish foundation species may (for example) alter boundary flow conditions, sediment stability, provide substrate for settlement and, consequently, form a 'biogenic' (living, three dimensional) habitat with an associated community composition and biodiversity.

Shellfish provide many **ecosystem functions** from the organisms themselves and the habitats they create (Figure 1). These include:

- Water filtration – As shellfish filter water to consume their food, they also remove suspended particles, contaminants and excess nutrients, such as nitrogen, that they can either incorporate into their shells and tissues as they grow or release back into the environment through their biodeposits.
- Nutrient and chemical cycling – Shellfish play an important role in denitrification and carbon cycling and sequestration (i.e., the processes of taking excess nitrogen and carbon out of the water and storing it).
- Sediment stabilisation – Shellfish have a positive effect on sediment stability and coastal erosion; both are global issues as storm events are increasing with climate change. Their filtration also acts to remove excess phytoplankton, increasing light levels at the seabed, that together with the nutrients shellfish excrete, enhances and reinforce seabed plant growth, further stabilising the seabed.
- Biodiversity enhancement – Shellfish beds are known to be biodiversity hotspots as many marine organisms, including a wide range of invertebrates, fish, and algae, can be found amongst the shellfish.
- Habitat complexity – A shellfish bed creates a complex structure with crevices that provide habitat and protection of other organisms. This habitat complexity is an important driver of biodiversity.
- Food provision – Shellfish are important parts of coastal food chains as many organisms rely either directly on the shellfish as a food source or benefit from shellfish habitats to provide a food source (e.g., sea cucumbers feed directly on shellfish biodeposits).

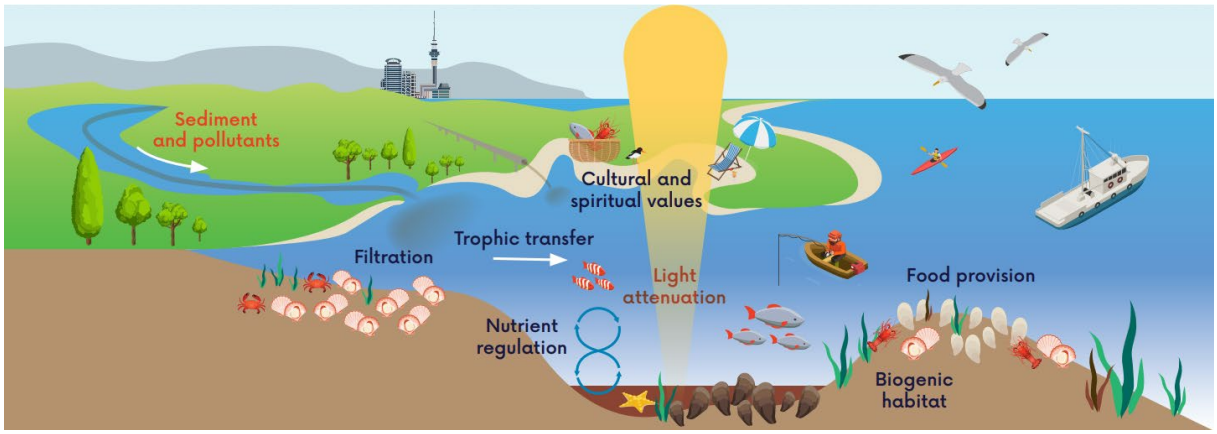


Figure 1: Ecosystem functions of shellfish provide many important ecosystem services that benefit both marine organisms and humans. Sourced from Rullens et al (2020).

Through these ecosystem functions, shellfish provide direct benefits to humans known as **ecosystem services** (Figure 2, Figure 3). These include:

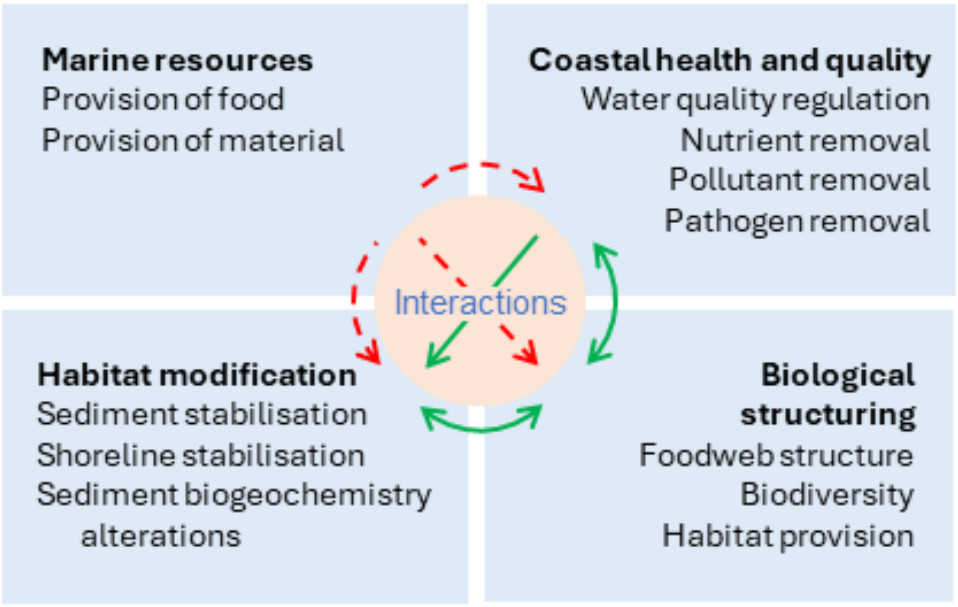
- Water quality improvement – Through water filtration shellfish clear suspended particles, including sediment and pollutants, reducing turbidity and improving water clarity. Increased water quality is important for many reasons, including biodiversity and tourism.
- Carbon sequestration and denitrification – Both carbon sequestration and denitrification are important for mitigating the effects of climate change.
- Coastal protection – Shellfish can play an important role in armouring coastlines, helping to reduce wave action from the ocean. This process helps to mitigate erosion and reduce the impacts of storm damage on coastal land.
- Cultural significance – Shellfish are important kai (food), especially to Māori as collecting kaimoana (food from the ocean) is a key cultural practice.
- Economic significance – Shellfish are part of important global fisheries, either through direct harvesting or aquaculture. Mussels and oysters are common aquaculture species and provide important economic value in Aotearoa New Zealand.
- Fisheries enhancement – As shellfish habitats create healthy, biodiverse ecosystems that can be important juvenile fish nurseries, there are many direct benefits for both recreational and commercial fisheries.

Although ecosystem services can be discussed and categorised as values to humans, it is important to point out that there are cultural Māori values that go well beyond human-centric ecosystem services.

Ecosystem services need to be strategically managed in order to ensure their sustainable use (Rullens et al., 2019). This is because ecosystem functions and services don't act in isolation, instead they occur simultaneously and can affect one another (i.e., a trade-off) or can work together (i.e., a synergy). Examples of ecosystem services of shellfish and the interactions including trade-offs and synergies are demonstrated in Box 2.

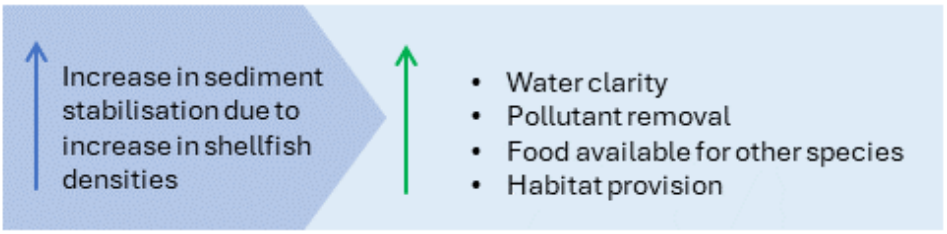
Figure 2: Ecosystem services provided by shellfish. A) Cultural significance: A family fishing and hand gathering on an intertidal green-lipped mussel bed (Katherine Burnham, UoA), B) Habitat provision: A decorator crab living inside a rehabilitated green-lipped mussel bed (Crispin Middleton, NIWA), C) Fisheries enhancement: A blue cod on a rehabilitated green-lipped mussel bed (Louis Olsen, NIWA), and D) Coastal protection: Green-lipped mussels armouring rocks in the intertidal (Emilee Benjamin, UoA). Images reproduced with permission.

Box 2. Ecosystem services provided by shellfish. The ecosystem services provided by shellfish can be grouped together into four 'bundles', with interactions within and between these bundles. Adapted from (Rullens et al., 2020).



Trade-offs (shown by orange dashed lines) occur when an ecosystem service (e.g. harvesting of shellfish) increases and causes declines in other ecosystem services:

Synergies (shown by green lines) occur when one ecosystem service (e.g. increase in shellfish densities) enhances another:



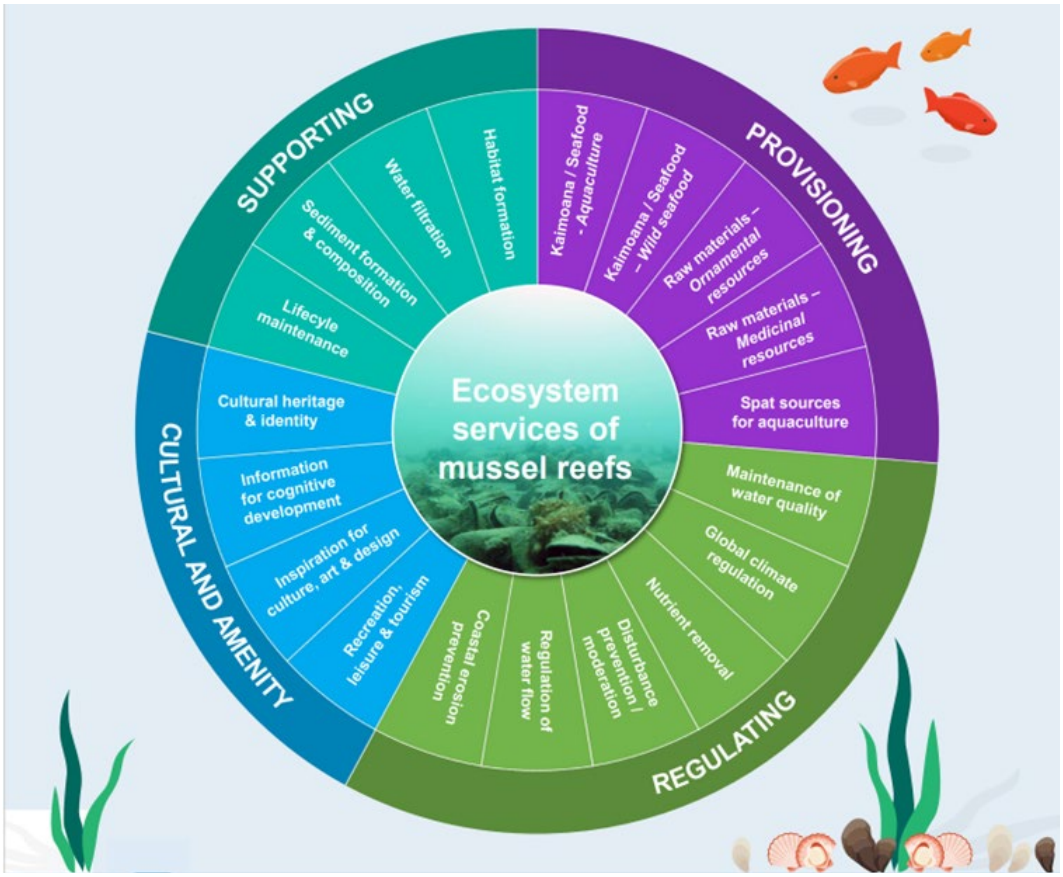


Figure 3: Ecosystem services that may be provided by seabed mussel restoration initiatives. (From Douglas et al., 2022).

2.2 Pressures on and vulnerability of shellfish and marine habitats

Despite the benefits of shellfish to the marine environment and the ecosystem services they provide to humans, there are many stressors that can impact these important organisms (Figure 4). The level of impact they each have on shellfish varies, ranging from reducing future resiliency to complete degradation of their habitat.

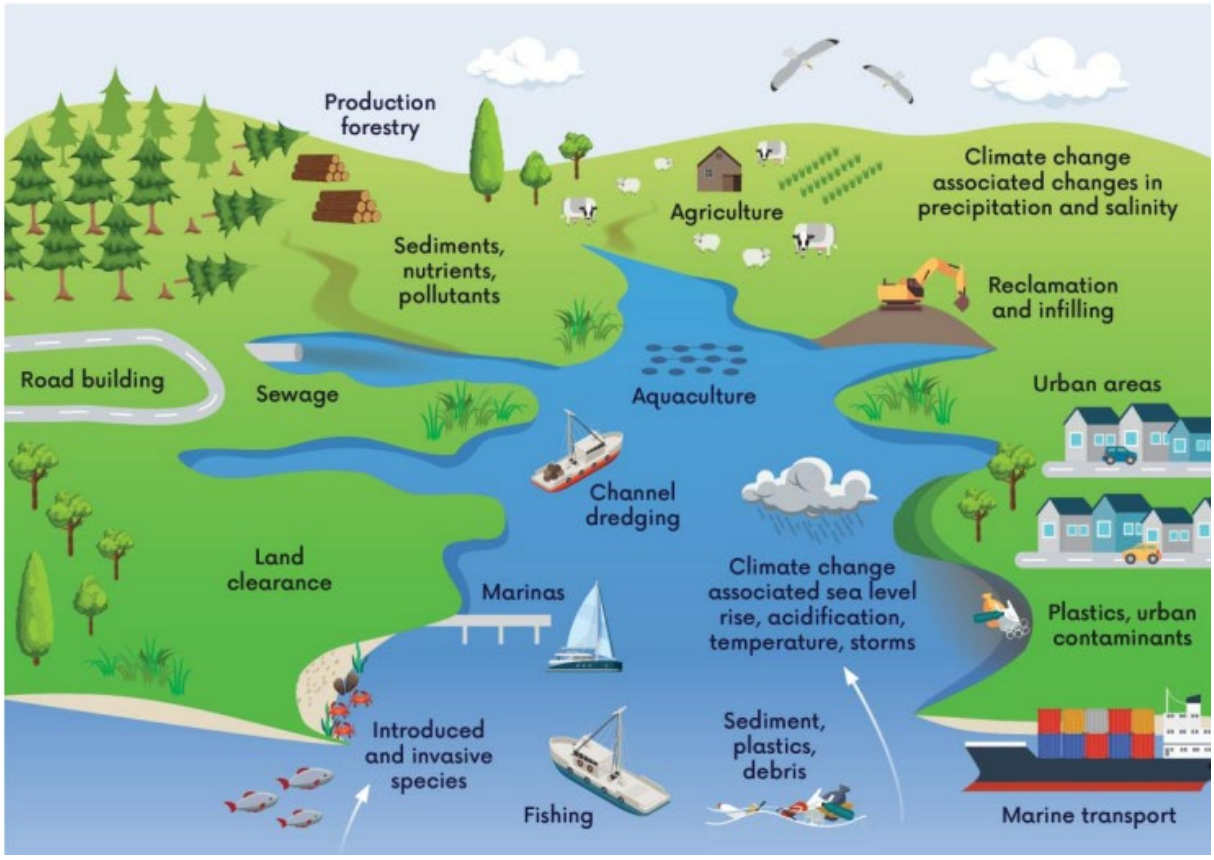


Figure 4: Stressors and pressures affecting shellfish beds. (Sourced from Rojas-Nazar et al., 2023).

These stressors include:

- Harvesting - There are many different harvesting pressures on shellfish including commercial, recreational, customary, and illegal unreported and unregulated fishing. Overharvesting - harvesting shellfish at a rate higher than that which ensures their sustainability - can severely limit shellfish resilience and natural recovery from disturbance.
- Seafloor disturbance – Some fishing methods (i.e., bottom trawling and dredging) can cause significant disturbance to the seafloor, and so to shellfish beds and habitats. Dredging occurs for both harvesting shellfish (mainly occurred historically in New Zealand) and for the maintenance of port access. Both can have significant impacts on shellfish either from damaging or completely removing shellfish and homogenising the habitat they create, from the disposal of sediments (dredge spoil), or from suspension of sediments in the water column. Excess fine sediments in the water column particularly affects survival of juvenile shellfish, limiting their recruitment (e.g., Hale et al., 2023).

- Climate change – Climate change has many potential impacts on the marine environment, including through increasing ocean and air temperatures, ocean acidification, extreme weather). These issues can significantly affect shellfish stress and survival and their ability to produce a strong shell, and future climate scenarios may increase the impact of these pressures.
- Pollution – Run-off from agriculture, urban, and industrial areas can ultimately reach and pollute the sea. This can include direct discharges of sewage, pesticides, plastics, metals, chemicals and nutrients into waterways.
- Nutrients – Excess nutrients can come from many sources, including run-off of fertilisers, animal waste, human sewage treatment or septic tanks. These excess nutrients can expose shellfish to many pollutants, such as nitrogen, which can affect their health and survival.
- Sediments – Sediment from land can enter the ocean for many reasons including land use changes, catchment development, forestry clearance or coastal erosion and during storms. Increases in sediment can cause death or decline in the health of shellfish, either from direct smothering by sediment deposits or by elevating the concentrations of sediments suspended in the water column, which affects the ability of shellfish to properly filter feed. The latter also affects light available to primary producers (macroalgae and phytoplankton) and so their ability to photosynthesise. Negative effects on primary production can affect availability of food and settlement surfaces for shellfish.
- Invasive species and disease – Invasive species can introduce a variety of stressors for shellfish including an increase in predators, competition for food and space. Change in environmental conditions can lead to the establishment of parasites and disease in areas that were previously unsuitable for their persistence.

2.2.1 Cumulative effects

Environmental stressors can overlap in space and/or time and, often, the impacts from multiple stressors can accumulate to cause greater impact. For example, sediment inputs and bottom-disturbance fishing (e.g., dredging or bottom-trawling) can together change the seafloor sediment characteristics (e.g. by making it muddier and more similar (or homogeneous). These impacts from multiple stressors are known as 'cumulative effects'. Also important are legacy effects (e.g., historic human colonisation and land-use change; (e.g., historic human colonisation and land-use change; Handley et al., 2020).

> *"Cumulative effects can be thought of as an accumulation of all stressors and activities that impact Te Ao Tūroa – as experienced, determined and described by iwi and hapū"* (Hayden et al., 2023).

Generally, adding more environmental stressors to a system reduces its resilience. For example, ecosystems with turbid waters, due to high concentrations of suspended sediments, are less resilient than those with clear waters (Thrush et al., 2021). This is because light penetrates deeper in clearer waters, enabling photosynthesis by plants at the seabed as well as processing of oxygen and nutrients. More turbid areas have reduced diversity of species living in the sediments, and can be more vulnerable to other stressors, such as increased levels of nutrients (Gammal et al., 2022) and disease.

Cumulative effects may occur for a variety of reasons. Interacting stressors that occur simultaneously, or stressors may be incremental or accumulating and add up over time. For example, over time run-off from land onto a shellfish bed brings with it excess sediment, nutrients, and pollutants that can gradually degrade the shellfish bed (Figure 4). These cumulative effects can occur from either a single stressor or multiple stressors (e.g., run-off and channel dredging) and have direct (e.g., inability to efficiently filter feed when excess sediment enters the water column) or indirect effects (e.g., channel dredging reducing habitat availability). Cumulative stressors can occur from past stressors (e.g., historical land-use changes) and can be worsened by the effects of climate change (e.g., increasing storm events causing more land-run off).

For these reasons, the cumulative effects of multiple stressors are best considered by focussing on the ecological response footprint, rather than the stressor footprints (Low et al., 2023). The use of response footprints is particularly useful for shellfish as they allow us to understand the wider implications of a stressor. For example, if a source of spat is within a stressor footprint, the ecological response footprint is much wider because these spat naturally disperse outside of the area as they grow to become juveniles and adults. Thus, the ecological footprint is much wider than the stressor footprint (resulting in fewer juveniles and adults in areas outside of the stressor footprint).

2.3 Improving health of shellfish and shellfish habitat

Globally, there is awareness around the importance of shellfish and the pressures resulting in shellfish declines. As a direct result there is an increase in interest to improve, restore, and rehabilitate shellfish populations and habitats and the ecosystem services they provide. Restoration aims to assist an ecosystem in its recovery back to a pre-degraded state, while rehabilitation aims to recover and re-establish the ecosystem functionality. The international restoration standards, developed by the Society of Ecological Restoration, have created a restorative continuum that demonstrates the different stages of restoration (e.g., see Gann et al., 2019). However, cumulative stressors, including climate change, can cause ecosystems to change, and restoration back to a predegraded state may not always be possible.

There are many different types of activities and interventions that can improve the health and recovery of shellfish and their ecosystem services. The specific actions that are required to improve the ecosystem can be highly localised and dependent on the particular shellfish species and on the pressures resulting in their decline (Figure 5).

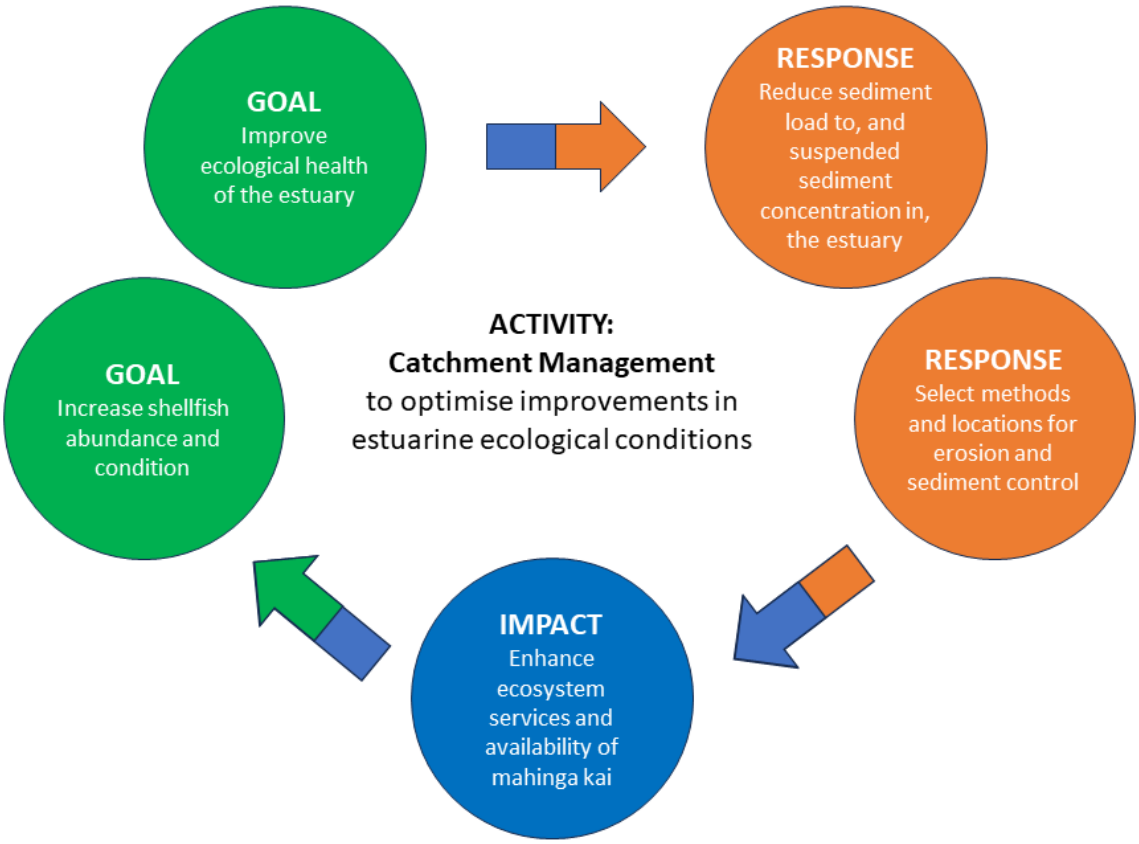


Figure 5: An example of an estuary management activity towards achieving higher level goals, including improving shellfish abundance and condition. The stressor is sediment input into the estuary, which is addressed via responses at a catchment management level. (Adapted from Giles & Lundquist, 2023).

Although the specific nature of rehabilitation activities is largely localised, interventions to improve the health of shellfish beds can be broadly placed into two categories, passive and active (Gann et al., 2019).

- Passive interventions – This invention type includes reducing environmental pressures (such as agricultural run-off or riverine sediment inputs), but no other action is taken. The goal of this intervention type is to allow the shellfish to recover naturally by reducing the pressures involved in the degradation or decline. Stressor characteristics can be used to determine those stressors that are likely to have most effect and thus be the most useful to remove (Gladstone-Gallagher et al., 2024).
- Active interventions – This intervention type includes actively implementing a rehabilitation action, such as transplanting healthy shellfish sourced from aquaculture into a previously overharvested area. Active interventions can often include a combination of actions working simultaneously to improve the health of an ecosystem.

All interventions (i.e., passive and active) need to consider the ecosystem beyond the shellfish. This includes understanding the pressures on both the shellfish habitat and the wider ecosystem and the connectivity of the "place" to the wider ecosystem as being able to support natural recovery. This information can be used to guide the types of intervention to best enable rehabilitation of the shellfish ecosystem (Hewitt et al., 2022). As marine ecosystems are complex, with many interactions between organisms and their environments, it is important to consider the system more holistically when identifying methods of rehabilitation.

2.4 Ecosystem based management (EBM)

Ecosystem Based Management (EBM) is an integrated approach to management that considers the entire ecosystem. It was defined within the Sustainable Seas National Science Challenge as "*a holistic and inclusive way to manage marine environments and the competing uses for, demands on, and ways that New Zealanders value them"* (Figure 5).

> *"EBM … recognises and incorporates the ecological complexity associated with environmental problems and the interdependencies of organisms (including humans) and ecological processes, as well as the potential for multiple interacting causes of specific problems"* (O'Higgins et al., 2020).
>
> *"A common factor in much of EBM is the inclusion of different stakeholders to understand the needs and behaviours of different groups, to identify trade-offs and develop consensus" O'Higgins et al. 2020 "describes the comprehensive integrated management of human activities based on the best available scientific knowledge to achieve sustainable use of ecosystem goods and services and maintenance of ecosystem integrity"* (Le Tissier, 2020).

To succeed, EBM requires involvement of multiple groups with their diversity of uses and interests in the marine environment. Their engagement is essential to the evolution and ongoing improvement of management processes.

The Sustainable Seas National Science Challenge has designed an EBM approach tailored to our specific context here in Aotearoa New Zealand (Hewitt et al., 2018). This EBM approach is founded upon seven principles that provide a holistic and inclusive way to manage marine environments and the competing uses for, demands on, as well as ways they are valued (Figure 6). This EBM approach aims to allow various actors within the marine governance and management to better understand the implications of resource management decisions and manage the interface between land and sea more effectively.

Figure 6: The Sustainable Seas National Science Challenge's conceptualisation of EBM for Aotearoa. The definition, objective, and mission were developed with input from stakeholders and Māori partners and were anticipated to evolve (Hewitt et al., 2018).

Sustainable Seas researchers have also considered the use of EBM by Māori. (Taylor & Hikuroa, 2024) comment that "*Some Māori scholars suggest it is possible to use "ecosystem" thinking under certain conditions. For example, (Harmsworth & Awatere, 2013) argue that respecting and valuing the Māori world view and Māori concepts is an essential first step to understanding the iwi/hapū perspective of ecosystems."* (see Box 3).

Effective and inclusive EBM is essential to underpin the long-term success and persistence of any rehabilitation activities.

Box 3. Ecosystem-based management and Te Ao Māori. (From Taylor & Hikuroa, 2024)

In a settler colonial context such as Aotearoa New Zealand, there are significant tensions that arise as different worldviews come into contact. For instance, both the Challenge Objective *(Enhanced utilisation of our marine resources within environmental and biological constraints)* and the Challenge Mission *(Transformation of Aotearoa New Zealand's ability to enhance our marine economy, and to improve decision-making and the health of our seas through ecosystem-based management)* emphasise human use and economic productivity, which reflects the political economic context within which science funding in Aotearoa New Zealand is determined. This can be seen as the continued privileging of western 'modernist' onto-political perspectives and governance agendas that have emerged through colonial expansion. 'Modernity' is an ensemble of socio-cultural norms, attitudes and practices that follow enlightenment thinking and a tendency to separate nature from culture. According to Fisher et al. (2022) "modernist governance arrangements, therefore, tend to simplify the natural world and the myriad socio-natural relationships that exist in relation to places, to conceive of participation, rights, and property in constrained terms and rely on prescriptive or technocratic solutions to address environmental problems (DePuy et al., 2021; Makey, 2021). In contrast, Māori-led and Māori-centric research undertaken in the Challenge emphasises values beyond economic value, and an understanding of the moana that emphasises relationality and connection between tāngata whenua and te taiao (the environment) across past, present, and future generations. Moreover, research that emphasises the agency and mana of tāngata whenua in exercising authority, the reimagining of economic futures and an indigenised blue economy, and which contemplates new models of marine management that better reflect Te Tiriti rights and interests represent important developments to challenge 'modernist' assumptions underpinning governance and management.

Notwithstanding the 'baggage' that accompanies EBM as a western concept (Fisher et al., 2022), there is evidence of EBM enabling a shift to more holistic and inclusive management practices in Aotearoa that are better able to accommodate Māori rights and interests and expression of Te Ao Māori. However, the relationship between EBM and kaitiakitanga requires careful navigation to ensure that rangatiratanga, mātauranga and tikanga of mana whenua is foregrounded and respected.

2.5 Rehabilitation of shellfish and shellfish habitat in Marlborough Sounds

The Marlborough Sounds is a large and ecologically diverse area with multiple values. The Sounds ecosystem underpins a high value marine economy that includes more than half of NZ's aquaculture resources. Shellfish represent a functional group of organisms that are critical to sustaining healthy seabed habitats and the wider Marlborough Sounds ecosystem. Shellfish are key to ecosystem services, tangata whenua and the shellfish industries of the Marlborough Sounds, and there is widespread recognition that shellfish health must be improved.

The Marlborough Sounds faces a range of environmental stresses. Most notable are those associated with land use changes, including farming and forestry activities, which have degraded marine habitats over time (e.g., Coutts & Urlich, 2020; e.g. Fahey & Coker, 1992; Handley, 2015; Handley et al., 2017; Urlich, 2015; Urlich & Handley, 2020a, 2020b). Widespread deforestation of the region after the arrival of Europeans in ca.1850s, and subsequent pressures from marine (shipping, fishing,

aquaculture, coastal infrastructure) and land-based activities (land-use change, farming, forestry, effluent discharge, etc.) have driven the changes seen today.

Specific evidence of compromised quality and issues regarding the abundance of shellfish and shellfish beds includes:

- the current closure of the scallop fishery (FNZ, 2018; MPI, 2016, 2017);
- halving of pāua quota in recent years (MPI, 2021);
- reports of highly compromised estuaries (Johnston & Floerl, 2023; MDC, 2023);
- reports of the loss of sub-tidal shellfish beds (Urlich & Handley, 2020a);
- reports of kina barrens (https://www.sustainableseaschallenge.co.nz/news-and-events/news/kina-removal-shows-promising-outcomes-for-kelp-forests/).

2.5.1 Why improve shellfish and shellfish habitat?

Improving and rehabilitating shellfish and shellfish habitat across the Marlborough Sounds may re-establish the ecosystem services and functions that the shellfish provide. This could include significantly changing the current state of the marine environment in some locations from one of high turbidity with declining fish, macroalgae, and shellfish populations, to a healthy, resilient, biodiverse ecosystem.

Rehabilitation of shellfish can

- reverse the declining state of coastal and marine habitats;
- build habitat and species resilience;
- future proof and improve negative trends in shellfish populations;
- reinstate a traditional food source;
- improve water quality;
- increase fish numbers;
- enhance and improve biodiversity.

In some cases, rehabilitation of shellfish can quickly improve biodiversity and other ecosystem services.

Example: Green lipped mussels in Marlborough Sounds. An active intervention technique was used to rehabilitate green-lipped mussel beds into five locations in Te Hoiere/Pelorus Sound, Grant Bay, North of Māori Bay, and three locations in Kenepuru Sound. Mussels sourced from aquaculture were placed onto the seabed in locations that were historically overharvested by dredging of mussels. Within the first year of the newly deployed mussel beds being in place, more demersal (or benthic) fish, invertebrates, and algae were observed living amongst the mussels compared to the adjacent soft-sediment areas (E. D. Benjamin et al., 2022).

Figure 7: Two rehabilitated mussel beds in the Marlborough Sounds. Within the first year after deploying the mussels onto the seabed, these mussel beds had a higher number of invertebrates including eleven-armed sea stars, demersal fish including triplefins (left, Louis Olsen NIWA), and macroalgae (right, Sean Handley NIWA) compared to adjacent habitats. (Data sourced from Benjamin et al., 2022).

2.5.2 Cautions regarding rehabilitation of shellfish and shellfish habitat in Marlborough Sounds

Due to widespread changes in the Te Tau Ihu marine environment, rehabilitation actions can't always be expected to fully return the ecosystem to pre-degraded conditions (i.e., full ecological restoration). It is important to recognise the limitations of what can be achieved, and to target goals accordingly. This can be done through having a good understanding of:

- The **biology and ecological requirements of the shellfish**. What does the species need to thrive at different stages of its life cycle?
- The **history of the ecosystem** and shellfish population. What past pressures have resulted in a decline in shellfish abundance and where did that occur? What other organisms, including predators, have been affected by these pressures?
- The present-day **characteristics of the area to be restored**. What pressures or stressors are currently acting on the area, and when (e.g., all the time, seasonally, sporadically)? Are they stressors that would negatively affect the shellfish? Can they be minimised?
- How the **area is expected to change** in the future, due to pressures stemming from climate change. Will historic habitats still be suitable in the future? Will there be more competition for space due to climate extremes (e.g., heat waves reducing suitable habitat or sea level rise "squeezing" the intertidal)?

3 What rehabilitation initiatives need to include and consider

1. Purpose and vision
2. Cultural perspectives and ecosystem-based management.
3. Process for developing and conducting shellfish/shellfish habitat rehabilitation.
4. Evaluating success.
5. Legislative requirements.

3.1 Purpose and vision

3.1.1 Develop and understand issues, visions and goals

Knowing why you want to undertake rehabilitation will determine your approach. This will depend on your overall vision, values, issues, and goals. It is important that goals are identified, discussed and agreed at the outset, and viewed as part of the wider management considerations of your area in question. As we discuss above, marine ecosystems do not occur in isolation. Land and sea are interconnected. Collective management of terrestrial factors (such as sediment input) connected to human land-use and freshwater health is crucial to the state of marine ecosystems and the success of rehabilitation projects. Scale is an important consideration.

Some examples of high level aims for large scale projects are provided in Table 1. Priority activities towards these high level aims will be multi-level, including those that can be undertaken by a range of groups (councils, central agencies, schools, community groups, tangata whenua).

However, not all initiatives will be large scale; the focus may be on improving the health of a small bay or beach, for example. In this case the aim may be to improve the health of the area so that resident shellfish grow to harvest size and are safe to eat, providing greater social/cultural value but little economic benefit. Smaller scale activities that align to local needs can also contribute meaningfully to a larger coordinated plan.

Table 1: High level example of potential desired outcomes of initiatives to rehabilitate shellfish and shellfish habitats at the scale of Marlborough Sounds.

Environmental	Social/Cultural	Economic	Management
Wairua and mauri of Marlborough Sounds shellfish is enhanced and maintained	▪ Shellfish abundance provides for recreational take ▪ Shellfish provide for cultural gathering in locations that are easily accessible	▪ Sustainable commercial harvest is provided for in key species ▪ Recreational harvesting ▪ Customary harvesting	▪ Joint shellfish management strategy and operationalisation across agencies and iwi ▪ Agencies and iwi collectively manage extraction sectors
Naturally functioning ecosystems are protected, restored and enhanced.	▪ Health of degraded ecosystems is improved, along with ecosystem functioning and services ▪ Marine biodiversity is improved. ▪ Ecological connections and resilience are protected, restored and enhanced	▪ Healthy functioning ecosystems don't require costly interventions to rehabilitate them	▪ Agencies and iwi collectively manage environmental effects of shellfish harvest ▪ Agencies identify and collectively manage environmental stressors

3.2 Cultural Perspectives and Ecosystem-based Management

"Māori values, knowledge and societal norms can make unique and transformative contributions to solving some of our most 'wicked' environmental and societal problems (Letica, 2020)."

3.2.1 Broader Context

This section provides context and guidelines for engaging Māori in marine initiatives, including rehabilitation activities. As well as drawing on larger bodies of research undertaken by the Sustainable Seas National Science Challenge (SSNSC), it also includes specific spotlights on engagement with local Marlborough Sounds iwi from Waitohi and Tōtaranui, Te Ātiawa o Te Waka-a-Māui.

The "Wai262" decision, (commonly known as the Indigenous Flora and Fauna Claim), is a landmark case in New Zealand that revolves around the rights of Māori in relation to the ownership and use of traditional mātauranga (knowledge), tikanga (cultural expressions) and taonga (indigenous species of flora and fauna). The decision has significant implications for engaging with Māori in various sectors, particularly regarding environmental management, intellectual property, and cultural heritage. The Wai 262 inquiry (focusing largely on contemporary relationships between the Crown and Māori) made recommendation that included a new funding agent for mātauranga Māori in science and Māori advisory bodies relating to patents and environmental protection.

Engaging with Māori is not just a legal or moral obligation but also a pathway to better outcomes, cultural enrichment, and creating stronger communities across Aotearoa, New Zealand. Meaningfully

engaging with Māori when planning and undertaking any rehabilitation/restoration project in the moana is therefore crucial for, several reasons:

1. **Cultural Perspective**: Māori have a deep connection to the land, sea, and natural resources, rooted in their cultural beliefs and traditions. The traditional ecological knowledge (mātauranga Māori) that Māori offer provides unique insights into environmental management and sustainability practices.

2. **Legal and Treaty Obligations**: The Te Tiriti, signed in 1840, is a foundational document in New Zealand that guarantees Māori rights and partnership in decision-making, including matters related to land, resources, and environmental protection.

3. **Holistic Approach**: Māori perspectives often emphasize holistic approaches to environmental management, considering social, cultural, economic, and environmental factors together. This aligns with modern concepts like ecosystem-based management and sustainable development.

4. **Effective Collaboration**: Working collaboratively with Māori enhances the effectiveness and legitimacy of environmental initiatives. Correctly executed it can foster trust, respect, and shared responsibility, leading to better outcomes for both the environment and people.

Today, Māori values, perspectives and knowledge systems (mātauranga Māori) are being increasingly used to inform collaborative processes to help manage ecosystems as government, councils, iwi/hapū groups, and communities engage collaboratively in decision-making, planning, and managing natural resources (Sinner & Harmsworth, 2015).

3.2.2 Enabling Ecosystem-based Management and Kaitiakitanga

Dr Robert Joseph's 'Treaty-based governance and EBM over the marine estate in Aotearoa' (Joseph, 2022), outlines the grim environmental state of our marine estate, and the proposed globalised solution of ecosystem-based management, but adapted to an Aotearoa New Zealand context. He refers to the seven key Sustainable Seas pou (pillars) (Figure 5) for implementing EBM locally. He then elaborates briefly on each pou from Te Ao Māori (worldviews), mātauranga (philosophy) and tikanga Māori (law) perspectives (Letica, 2020). The practice of Kaitiakitanga gives practical meaning to many of those seven principles (or pou).

In Te Ao Māori, **Kaitiakitanga** is variously defined but represents the obligation arising from a kin relationship to nurture or care for a person or thing. This obligation encompasses the need to care for and nurture not only physical but also spiritual well-being. It is an inherited commitment that links mana atua, mana tangata and mana whenua mana moana (hereafter referred to as mana moana)[1], te ao wairua (the spiritual realm) with te ao turoa (the natural world, including humans)(Selby et al., 2010). Kaitiaki are those that whakapapa to, and take responsibility for, a place and its natural elements. Kaitiakitanga is the active embodiment by humans in this role as kaitiaki[2].

Below, we briefly describe Te Kete Kaitiakitanga (Taylor & Hikuroa, 2024), a Sustainable Seas toolkit designed to enable and enhance kaitiakitanga and EBM across the whole marine and governance system. This document, presented in more detail in Appendix A, provides guidance on how to

[1] In this context reference to 'mana moana' encompass mana whenua and recognises the mana, mandate, authority and obligations a particular grouping of tāngata whenua has in relation to place (land or marine) and the ecosystems, taonga (gifts) and resources within.

prepare and engage with Māori for anyone looking to undertake activities within the marine environment. We also provide comment from Te Ātiawa o Te Waka-a-Māui Trust, on potential considerations they would expect researchers and project managers to make when starting research projects that require their involvement (see Appendix B).

> *"The inclusion of te ao Māori in scientific research can deepen our collective understanding of connections, interdependencies and long-term intergenerational perspectives (Letica, 2020)."*

Te Kete Kaitiakitanga

Te Kete Kaitiakitanga is a simple toolkit designed to enable and enhance kaitiakitanga and EBM across the whole marine governance and management system (Taylor et al. 2024).

Te Kete Kaitiakitanga aims to provide guidance and means of assessment to support ensuring kaitiakitanga is appropriately provided for alongside EBM. Applied as a package authentically and with genuine intention to honour the integrity of kaitiakitanga, Te Kete Kaitiakitanga offers a framework for transformative change.

The toolkit

Te Kete Kaitiakitanga comprises three simple tools:

- ***E Toru Ngā Mea*** – information to advise and help users gain an understanding of the critical elements required for Mana Moana involvement in marine governance and management.
- ***Mahi Tūhonohono*** – guidance to support users to provide for those critical elements to the necessary extent.
- ***Te Tiriti Relationship Enhancer*** – an assessment tool that enables users to evaluate their organisational approach to implementing marine governance and management in a way that provides equity of opportunities and outcomes across the socio-ecological and cultural seascape.

All three tools are centred around relationships, transparency and accountability. They aim to support equity and opportunity in the marine governance and management system - a system largely founded upon western approaches, structures, institutions, and knowledge. The tools enable users to explore relationships, knowledge and approaches founded in te ao Māori that offer the opportunity to enhance the well-being of people and the ocean through kaitiakitanga and EBM. In particular they aim to support making greater space for te ao Māori, particularly rangatiratanga (Māori leadership), mātauranga (knowledge and knowledge making), and tikanga (best practice).

3.3 The process and considerations for developing and conducting shellfish/shellfish habitat rehabilitation.

The process of restoration/rehabilitation can occur across a 'continuum' from unassisted or spontaneous regeneration to 'active restoration', with many actions or combinations of actions that may be considered as intermediate (Handley, 2022). These can vary from a large scale ecosystem focus to localised improvements and can require a range of efforts and investment (time and money) to plan and achieve.

Good rehabilitation initiatives will have broad engagement, including with community, tangata whenua and stakeholders, and will thus incorporate the needs and concerns of multiple people.

Good initiatives will have a clear and collective goal(s), strong leadership, and a collaborative and engaged working team. They will have evaluated and agreed on strategies that are effective and carefully considered potential risks, scientific information and legislative requirements (including customary), and will have ensured that their goals and actions/activities align with other actions/initiatives beyond their own. They will have a longer term plan for monitoring and measuring success (or failure) of the activities, and adapting these accordingly.

The steps below will help with identifying the issues, the goal and the process for action.

1. Define the **issue** to be addressed and the **goals**. What is the problem and what is the ultimate goal?
2. **Who** should be involved?
3. Understand **past/present/future actions**. Your work can be integrated with and benefit from other initiatives. Learn from and build on **existing knowledge** and **other rehabilitation initiatives**. Others may have trialled actions, investigated reasons for decline, suggested factors that should be considered.
4. Consider the ecological requirements of the species of interest.
5. Consider the feasibility, effectiveness, risks and benefits of the initiative. How **feasible and effective could the activities be?** Are there any **risks** (could they have unintended impacts)?
6. Develop an **action plan** as a group,

3.3.1 What is the issue to be addressed? What are the goals? *(develop a common understanding of the problem, and the ultimate goal(s))*

We recommend that the first action be a 'situation analysis'. During this process you can map out the issue on paper (Figure 8), with the aim of understanding the interacting factors and feedbacks (ecological, social and cultural) that influence the behaviour of your species or system over time. This has value, particularly with a diverse group, in understanding viewpoints beyond your own and thus ensuring that the group is on the same page in terms of their underlying knowledge. A more formal way of doing this is by developing a 'system map' (Figure 9; Connolly et al., 2020).

This overview helps with the next stages of the process through having a better understanding of the parts of the system which have the most influence, and therefore where any actions could be best directed to have the desired effect (Connelly et al. 2020).

This process is also good at highlighting gaps in crucial information and understanding, that can then be targeted for further investigation (see *Build on existing knowledge*, below). For example, what is the current understanding of ecosystem health, and the stressors they face? What is already known, and what more do we need to know?

Figure 8: **Example sketch of your harbour or estuary.** (From Cummings & May, 2009)

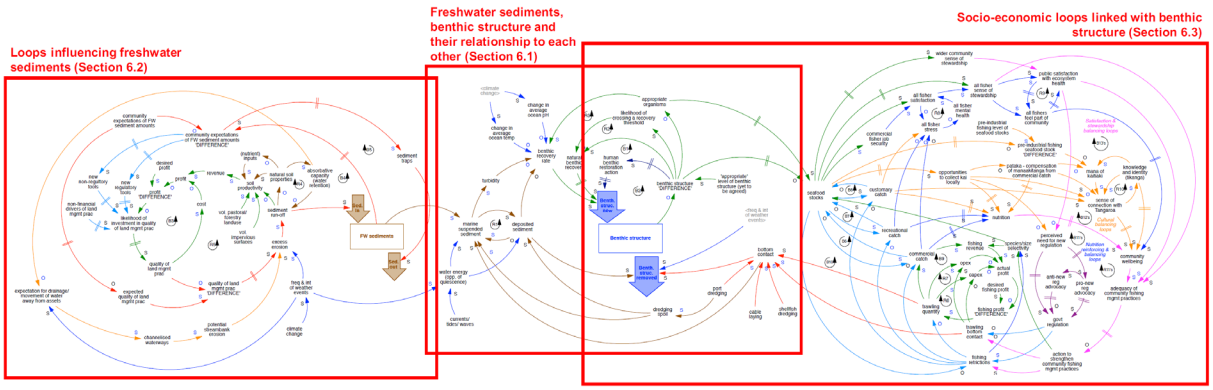


Figure 9: **A system map for Hawkes Bay.** The map was developed with members of the Hawke's Bay Marine and Coast group to address two of the key stressors contributing toward a degradation in marine ecosystem health - land-based impacts from sediment delivery, and disturbance to the benthic (seafloor) structure caused by bottom trawling. (Figure 13 from Connolly et al., 2020).

3.3.2 Who should be involved?

Consultation should be wide in the first instance. In a region with people with diverse interests, backgrounds and values, it is important to consider the different drivers, desires and needs across this broad spectrum of stakeholders. This will be key to defining the issue and refining your goal.

Co-governance, and so co-design, could be necessary to achieve the goal. To that end, the team could include organisations with management and governance roles and responsibilities in the area, and should include people with scientific knowledge and mātauranga Māori. Partners with different perspectives, and a range of knowledge and skill sets, will ensure the relevance and usefulness of the mahi identified.

It is recommended to appoint a group of people (a committee or steering group) who will have an overview of the project and can coordinate and keep track of the activity(ies), progress and to evaluate success.

3.3.3 What is already being done? Learn from and build on other rehabilitation initiatives *(integrate with other work completed, underway or planned).*

There is immense value in learning from previous projects and aligning with other initiatives, to avoid duplication and to build on existing knowledge or activities. For example, some high level rehabilitation initiatives already underway in the Marlborough Sounds include:

- Kotahitanga mō Te Taiao, which promotes collective action towards enhancing and protecting biodiversity in Te Tauihu, the top of the South Island. Kotahitanga mō te Taiao
- Te Hoiere/Pelorus Catchment Restoration Project, a community-driven, multi-partner environmental restoration project to revitalise Te Hoiere/Pelorus catchments from the mountains into the sea (ki uta ki tai). Te Hoiere Project
- Sustainable Seas/Our Land and Water estuary project, which evaluates the interaction between loadings of different contaminants from freshwaters on the health and functioning of estuaries. Ki uta ki tai: Estuaries, thresholds and values - Sustainable Seas National Science Challenge (sustainableseaschallenge.co.nz)
- The Southern Scallop Strategy: Marlborough Sounds, SCA7. This is a Fisheries NZ and Southern Scallop Working Group led strategy to rebuild scallop populations in Te Tau Ihu, with the immediate focus on the Marlborough Sounds. There are several steps to the strategy, which was approved by the Minister of Fisheries in 2020 (Southern Scallop Strategy Marlborough Sounds (mpi.govt.nz)). An implementation plan was developed in 2021 (Implementation plan: Southern Scallop Strategy: Marlborough Sounds (mpi.govt.nz))

We can learn much from the experience and mahi of others, who may have investigated reasons for population declines, suggested factors that should be considered, summarised the needs of different species, and trialled or implemented some activities. It is possible to implement initiatives and activities suggested by these projects, or to take their 'trial' activities to the next step. Considering existing knowledge and information can avoid repetition of mistakes/ineffective techniques, ensure complementarity and give your initiative a head start. Some Marlborough Sounds examples include:

- A recent review of activities or actions to reverse the decline in state of coastal and marine habitats and build resilience in these habitats (including marine restoration

techniques), for potential use in Te Tauihu (Top of the South Island). This review describes a range of options and includes case studies of each (Handley, 2022).

- Green lipped mussel reef restoration project in Te Hoiere (Benjamin et al. 2023; described below).
- Kina removal and seaweed restoration project in Tōtaranui/Queen Charlotte Sound. Initiated in 2022, this involved removal of kina from barrens at four locations in Tōtaranui, to facilitate the recovery of seaweeds grazed by the kina and restore habitat for predators such as crayfish and snapper (Kina removal shows promising outcomes for kelp forests - Sustainable Seas National Science Challenge (sustainableseaschallenge.co.nz).
- The FNZ scallop-focussed project "*Cumulative effects of stressors on scallops and scallop habitats in the Marlborough Sounds*", that assessed reasons for the lack of recovery of scallops in the region (Hale et al., 2023).
- Sustainable Seas National Science Challenge Ecosystem-based management of shellfish in the Marlborough Sounds project (described below).

Examples from elsewhere around Aotearoa-NZ include:

- Effective techniques for sea urchin removal for kelp forest restoration (Miller & Shears, 2022).
- Using natural fibre lines to help restore kuku/mussel beds in Ōhiwa Harbour, by catching mussel spat. Early signs of success at mussel 'restoration stations' - Sustainable Seas National Science Challenge (sustainableseaschallenge.co.nz)
- A FNZ scallop-focussed project seeking to identify factors inhibiting scallop recovery from both a biological and habitat perspective in Golden and Tasman Bays (Williams et al., 2023).
- Revive our Gulf, a large scale initiative to restore the mussel reefs of the Hauraki Gulf (Revive Our Gulf).
- Pāua stock enhancement method testing on the Kaikoura coast (Gerrity & Schiel, 2023), including juvenile reseeding, larval outplanting and outplanting of presettled larvae on small rocks.
- Cockle enhancement and seagrass bed transplantation techniques trialled in Whangarei Harbour (Hewitt & Cummings, 2013; Matheson et al., 2016)
- Shellfish closures. Examples include cockle beds at two locations on Banks Peninsula since 1995, via a mataitai, and Cheltenham Beach, Auckland, via rahui, since the early 1990s (Marsden & Adkins, 2010); pāua in the East Otago Taiapure (Gnanalingam et al., 2021).
- Fiordland Marine Guardians (fmg.org.nz)

Practical example: Shellfish and shellfish habitat in Marlborough Sounds

This example describes the first stage of a Sustainable Seas NSC project to explore ecosystem-based management in Marlborough Sounds, that focussed on planning for the management and

restoration of shellfish. The project began by gathering existing information on shellfish and their habitats in Marlborough Sounds (Step 1 in Figure 10). The next step was to review this information with the team and select species and areas of study (Step 2 in Figure 10). Current distributions of shellfish and shellfish habitat were mapped (Step 3 in Figure 10) and, for areas where there was enough information, predicted distributions of shellfish were modelled and mapped, based on observed data and environmental information (Step 4 in Figure 10).

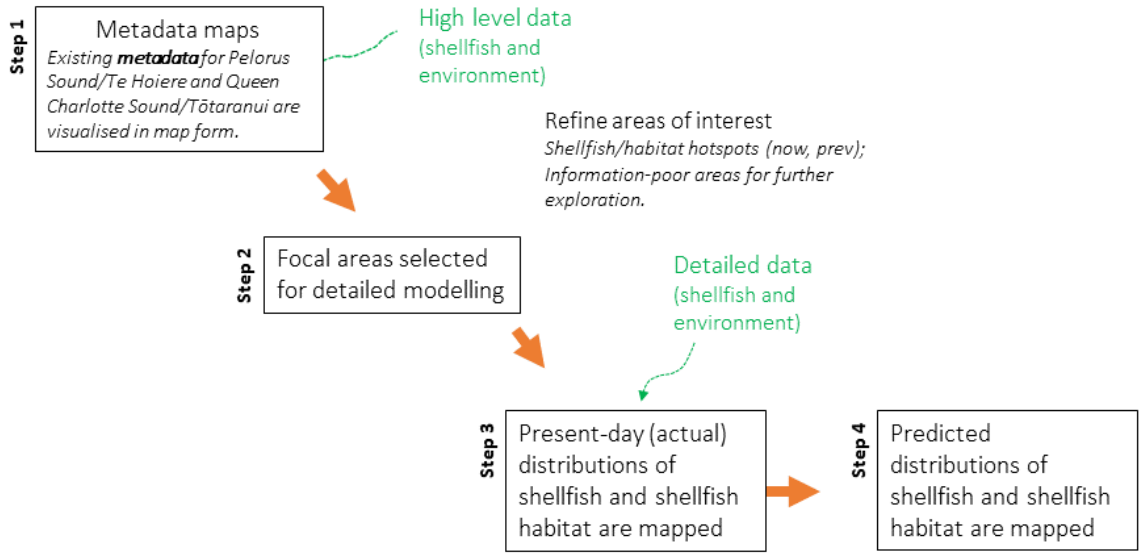


Figure 10: Marlborough Sounds regional study workflow.

Step 1: *Integrate existing information to map current knowledge of shellfish and their habitats in Marlborough Sounds*. This involved gathering existing high-level information on shellfish and their habitats in the Marlborough Sounds, as described below:

- Conducted a literature review and gathered information from other organisations and sources, to summarise the available high level shellfish-related information ("metadata") for both Te Hoiere and Tōtaranui.
- Included was information on shellfish species (presence, absence, densities), the environment (especially sediment types, bathymetry, water currents), and location (GPS coordinates).
- Only data collected recently (from 2015 to present) was considered, to be most relevant to the distributions of shellfish and their habitats today.
- This metadata was used to map current knowledge on shellfish distributions (Figure 11) and environmental information (Table 2).
- The metadata was used to identify areas with sufficient information to generate detailed species distribution maps (Figure 11) and, subsequently, predictive distribution maps.

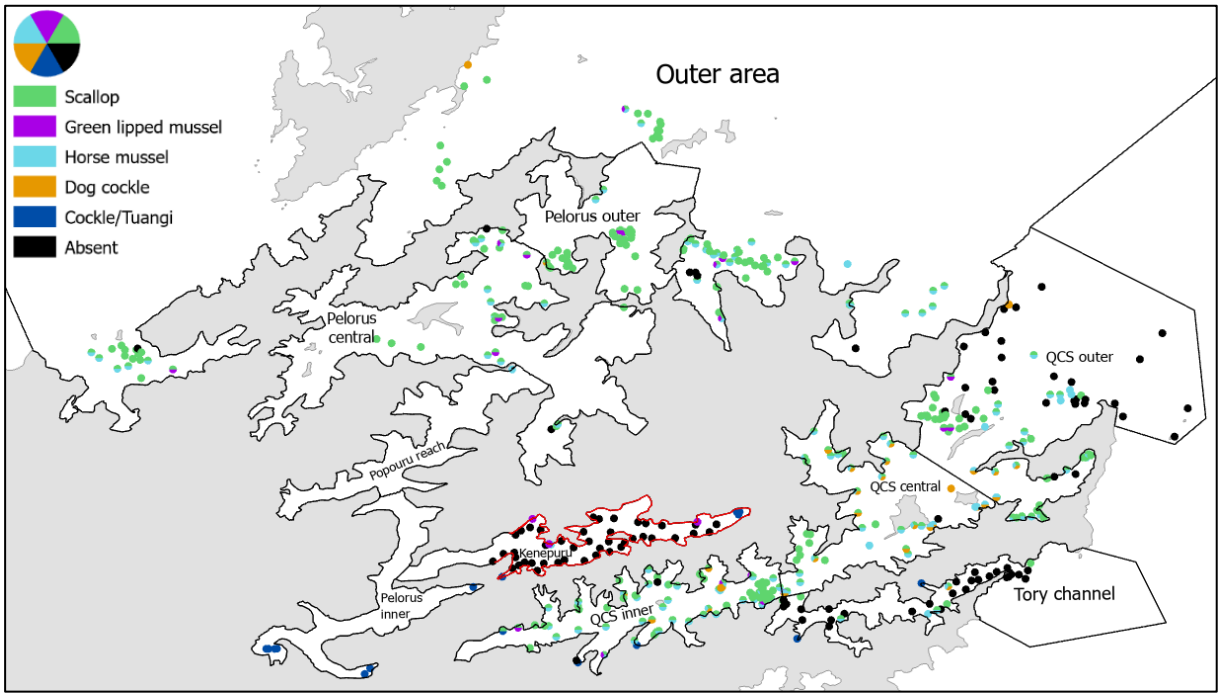


Figure 11: Marlborough Sounds, showing the distributions of the major shellfish species. These are: scallops, horse mussels, dog cockles, cockles/tuangi, and green lipped mussels). QCS = Totaranui/Queen Charlotte Sound.

Step 2: Review information and determine interest in species and areas of study.

Two virtual hui were held for those interested to provide feedback on (i) the metadata summaries and maps of the high level information on where shellfish species and environmental information, and (ii) recommendations for next steps of generating locations and species (including predictive distribution maps).

This resulted in a collective decision to focus on Outer Tōtaranui/Queen Charlotte Sound, in the area of Meretoto (Ship Cove) to East Bay, and to explore occurrences of multiple species (rather than a single species), recognising their combined importance to a healthy ecosystem. For example, horse mussels provide added structure to a sandy or muddy seafloor, which scallops and other shellfish species can use as habitat, and which also provides some refuge from predation.

Three species were selected that met the modelling criteria: scallops (*Pecten novaezelandiae*), dog cockles (*Tucetona laticostata)*, and horse mussels (*Atrina zealandica*) (Figure 12; Table 2).

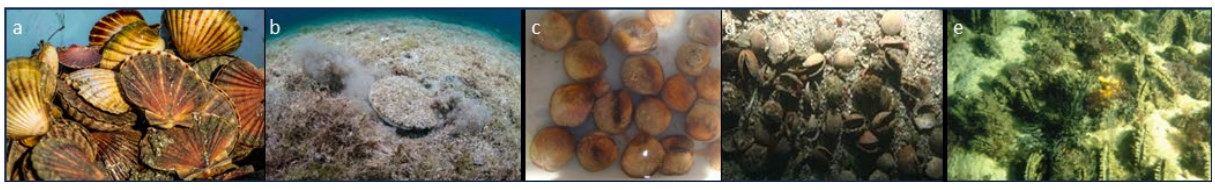


Figure 12: The three species that met modelling criteria. Scallops (a, b), dog cockles (c, d), and horse mussels (e). Image credits: a, NIWA; b, James Williams NIWA, c and d, Jennifer Beaumont, NIWA; e. Pip Nicholls, NIWA.

Table 2: Summary of metadata review for Marlborough Sounds shellfish and environmental information. Metadata are presented for five candidate species with sufficient numbers of records and geographic distributions for species distribution mapping.The species and locations with good, poor and marginal information are highlighted using green, red and orange, respectively. QCS = Tōtaranui/Queen Charlotte Sound.

Species with sufficient information?		Locations with sufficient information?									
		Te Hoiere/Pelorus Sound					Tōtaranui/Queen Charlotte Sound				
Shellfish	Decision	Pelorus Inner	Kenepuru	Popouru reach	Pelorus Central	Pelorus outer	QCS inner	QCS central	QCS outer	Tory Channel	Outer area
Scallops	YES	x	x	x	✓	✓	✓	✓	✓	~	✓
Horse mussels	YES	x	x	x	✓	x	✓	✓	✓	~	✓
Dog cockles	QCS*	x	x	x	x	x	✓	✓	~	x	x
Cockles/tuangi	NO	✓	~	x	x	x	~	x	x	~	x
Green lipped mussels	Kenepuru*	x	✓	x	~	x	✓	x	~	x	✓
Sufficient environ-mental data?	Multibeam layers (depth, roughness)	x	x	~	✓	✓	✓	✓	✓	✓	x
	Water currents (speed, direction)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Sediment type (mud, sand, etc)	x	x	x	~	~	✓	✓	✓	✓	x
		NO	NO	NO*	?*	?*	YES	YES	YES	YES	NO*

* data are marginal either because of low numbers of records, or lack of sediment data needed for modelling.

? Modelling may be possible with data on sediment type in the channels.

Steps 3 and 4: Model current and predicted distributions of shellfish and shellfish habitat.

Robust modelling of current and predictive (Figure 13) shellfish and habitat distributions requires (i) a reasonable number of data records that (ii) provide good spatial cover of the case study area, (iii) matching environmental data, and (iv) the shellfish dataset and environmental datasets need to match in time. (e.g. current day distributions cannot be predicted with historic environmental conditions).

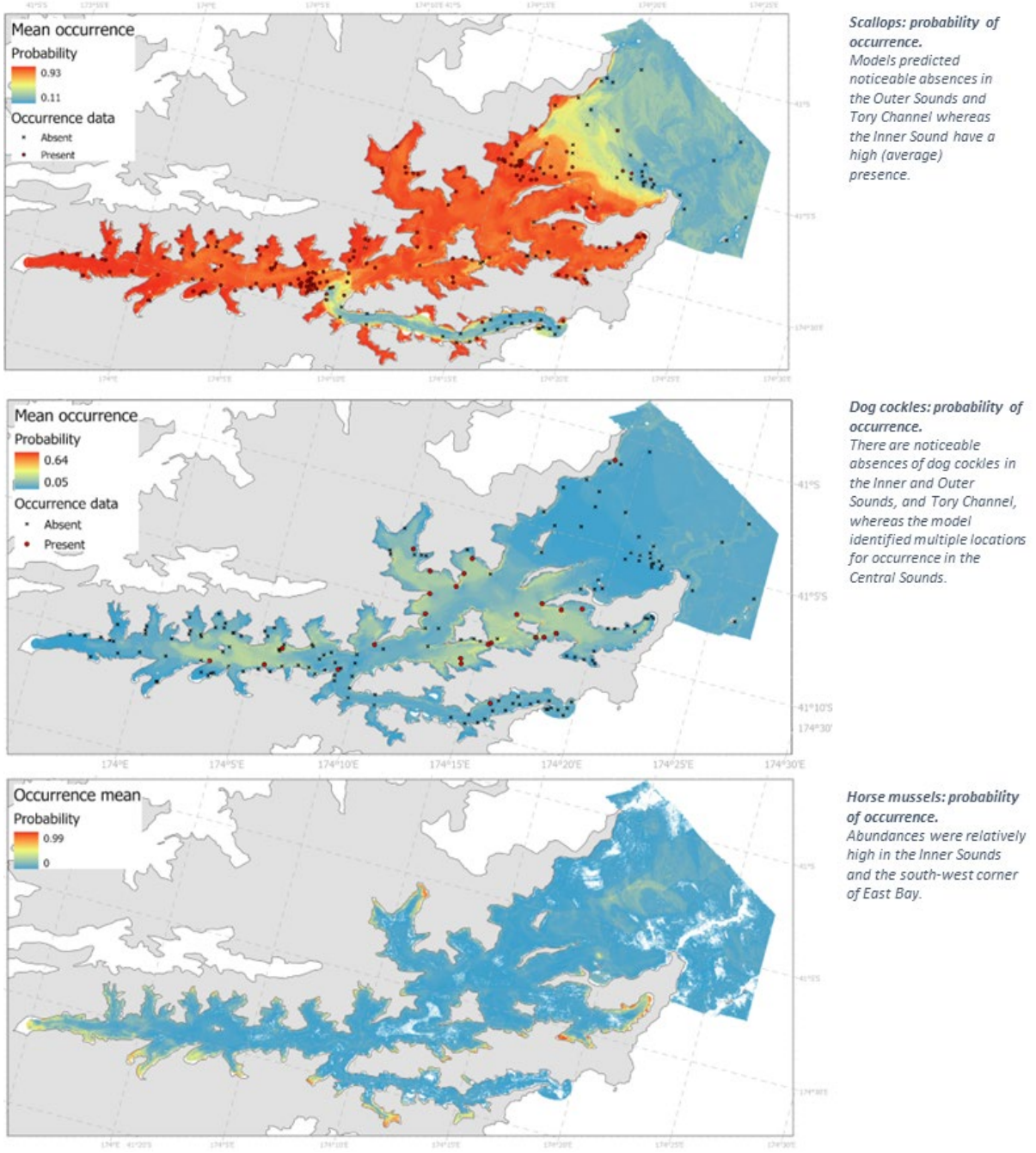


Figure 13: Modelled mean predicted probability of occurrence for scallops, dog cockles and horse mussels in Tōtaranui.. Occurrence data is overlain for absence (x) and presence (red ○). Models for *Pecten novaezelandiae*; top) and dog cockles (*Tucetona laticostata*; middle) were developed for the Sustainable Seas Marlborough Sounds Regional study, while those for horse mussels (*Atrina zelandica*; bottom) are from (Anderson et al., 2021).

3.3.4 Consider feasibility, effectiveness, risks and benefits

(What is the feasibility, effectiveness and impact(s) of our activities?)

> *Restoration projects take time and expectations need to be realistic – "restoration is a marathon and not a sprint"* (FNZ, 2023).

Before beginning, carefully consider each option for rehabilitation, and the planned actions that are required to achieve it. This should include evaluating the **feasibility** of implementing the action(s) (e.g. how difficult is it to do? what will it cost? do you have the capability?) and, if it were able to be implemented, how **effective** it would be towards achieving the goal (Figure 14, Figure 15). In many cases, evaluation of effectiveness may be difficult, depending on the extent of prior knowledge and understanding, and maybe a 'best guess'.

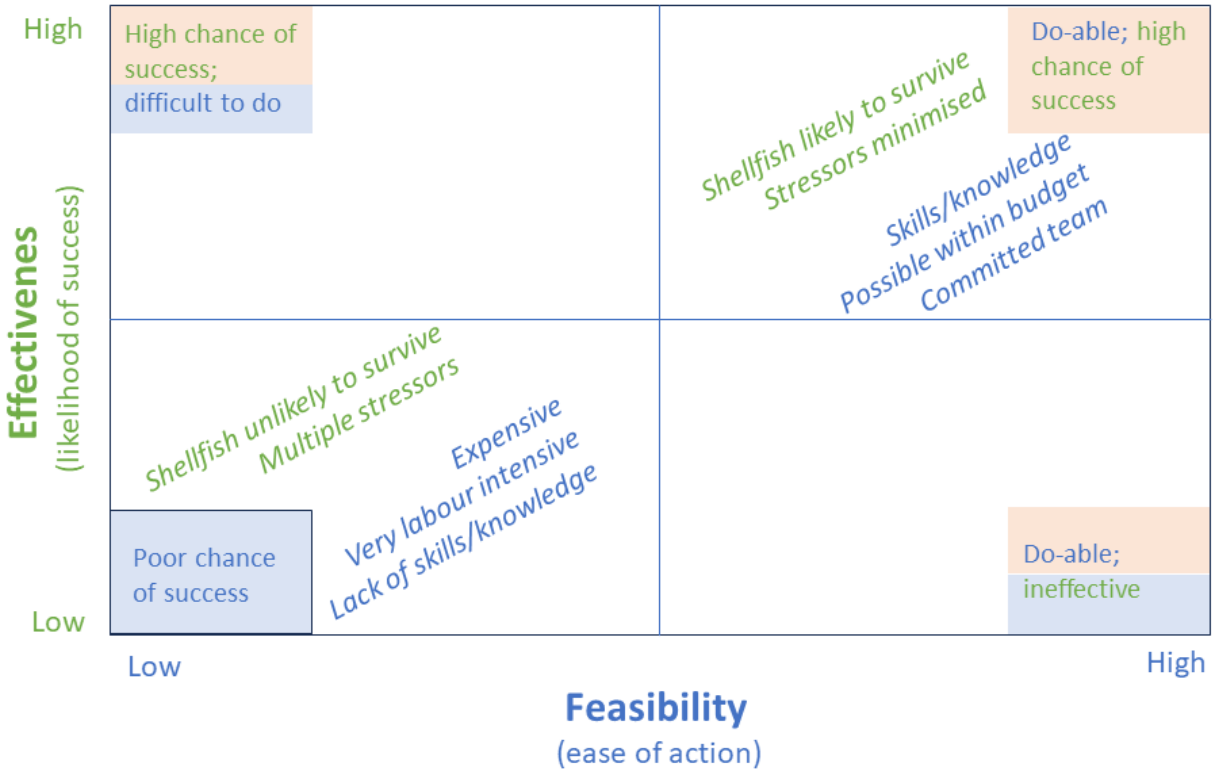


Figure 14: A matrix of feasibility and effectiveness; a useful tool to evaluate and select the best options for action.

As part of this evaluation, it is important to also weigh up the **risks and benefits** of these options, and to **think beyond the initial implementation**. Examples of risks include ecological and biosecurity ramifications of transplanting potentially parasite infested or contaminated shellfish, spread of invasive species into new areas (e.g. fan worms, tunicates, algae), or mixing of shellfish populations from different areas, which can reduce diversity (dilute the gene pool) of the species over larger spatial scales.

Whilst evaluating risk is important when initiating a project, it is important that this is re-evaluated routinely throughout the project's lifetime.

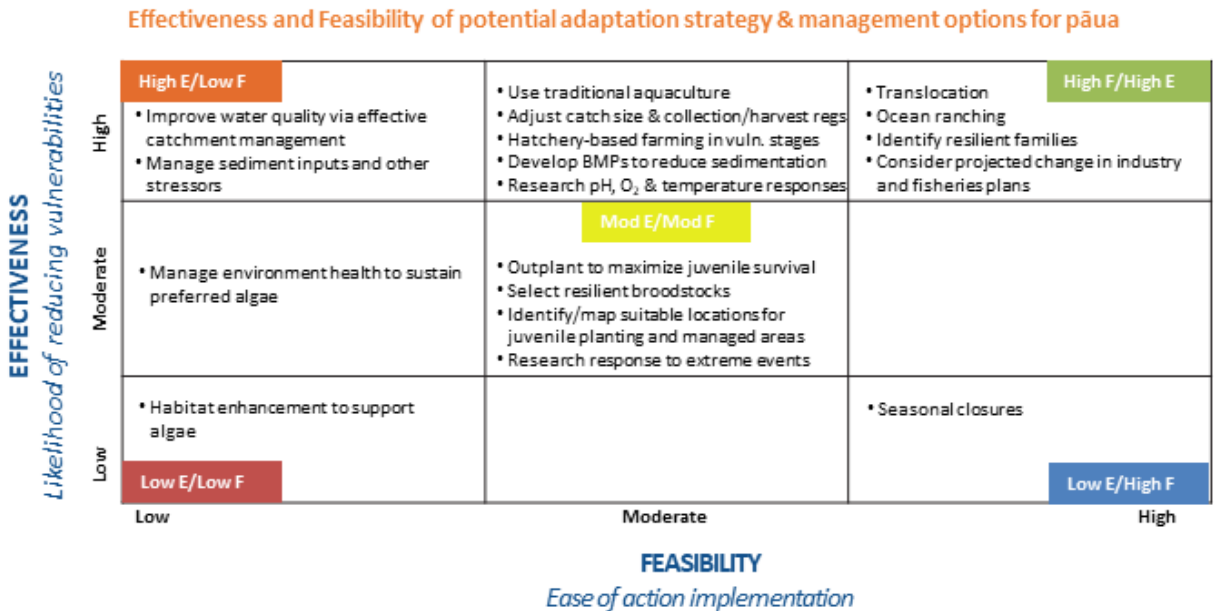


Figure 15: Effectiveness and feasibility matrix of different adaptation and management options to improve resilience of the pāua fishery to climate change. Excerpt from a risk and vulnerability assessment conducted by (Cummings et al., 2021). BMP = best management practises.

By leveraging and potentially incorporating research initiatives that are already underway - both in the region and elsewhere, feasibility and effectiveness may be enhanced. Initiatives in Marlborough Sounds could, for example, be guided by the objectives of the Kotahitanga Alliance (Kotahitanga Alliance, 2019), which have carefully laid out the process for considering and planning future activities;(e.g. Interagency Management Group's shellfish plan; Jorgensen, 2020) . Initiatives could also align with programmes that bring together the representation and interests of multiple parties (e.g. Te Hoiere Catchment Restoration Project, Southern Scallop Strategy). As noted above, it is possible to learn from initiatives that are underway elsewhere in NZ; for example, by linking with research teams working on shellfish restoration in the Hauraki Gulf and Ohiwa Harbour.

3.3.5 Consider species' ecological requirements

When the intent is to restore biodiversity and a natural functioning community through the enhancement of a foundation species, it is vitally important to understand the ecological needs and requirements of the species throughout its life history.

Life-stage habitat requirements

What does the species need to grow and survive (e.g. food, shelter, oceanographic conditions) at each life stage? What are the threats to the species (e.g. predators, sediments, ocean acidification)?

This understanding is essential to evaluating the suitability of the habitat, the timing of any activities, and the likely persistence of the species in the habitat. As an organism develops and grows, its habitat requirements will change and this may result in movement of the species away from the restored area at a later stage of development (Hewitt & Cummings, 2013). As a major goal is for the population to be self-sustaining, all of these considerations will provide information to increase the chances of the initiative being successful.

To illustrate the life-history requirements that should be considered in any rehabilitation activities, we describe below the life cycles of three common shellfish species – pāua, green-lipped mussels and cockles.

Pāua (abalone, *Haliotis iris, H. australis*)

Pāua are long lived sedentary marine snails, found in coastal rocky shore areas down to about 15 m deep. They are broadcast spawners, with females and males releasing eggs and sperm, respectively, into the water column at the same time for fertilisation (Hooker & Creese, 1995) (Figure 16). Aggregations of pāua are required for successful fertilisation (Babcock & Keesing, 1999).

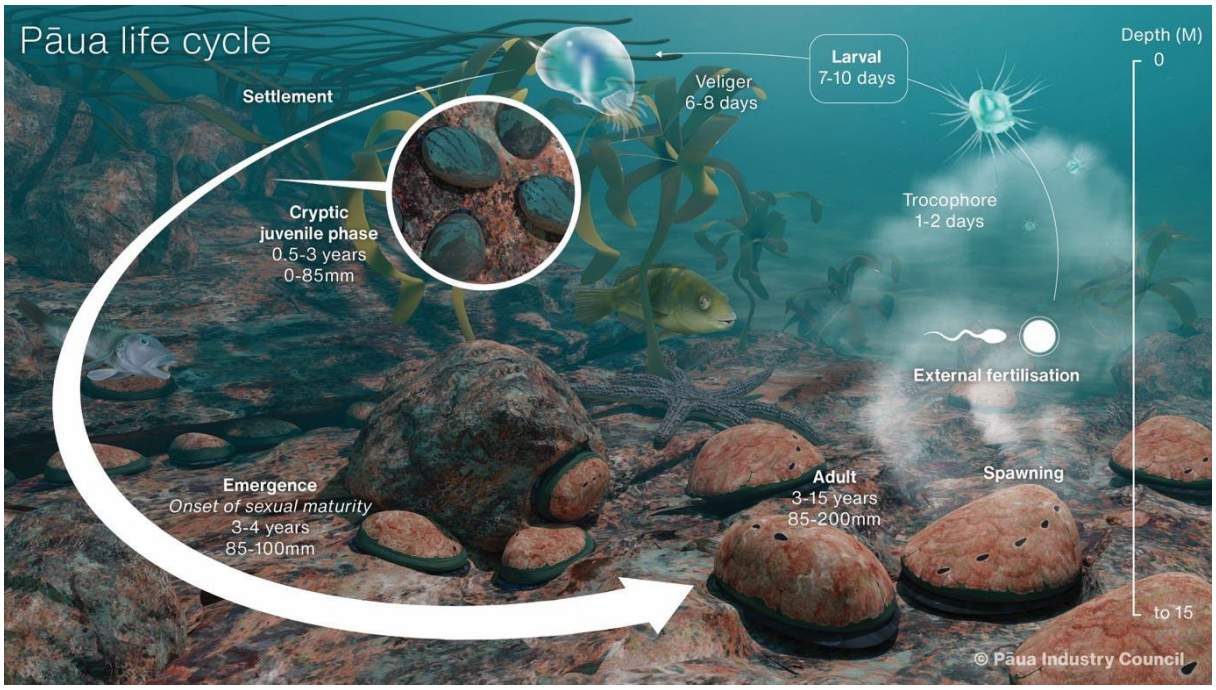


Figure 16: Life cycle of the New Zealand pāua. Credit: Pāua Industry Council Ltd.

In Marlborough Sounds, spawning has been observed in spring, but this timing is variable and uncertain. Their resultant larvae, which are free swimming and do not feed, live and develop in the water column for 10-14 days (depending on temperature), before they are able to settle to the seafloor. They prefer settling on crustose coralline algae (Tong & Moss, 1992). Once settled, they live amongst microalgae-covered boulder and cobbles, habitats with lots of crevices in which they can hide (Kawamura et al., 1998). Pāua adults (~70-80 mm shell length depending on the region they reside in) move into more open boulder habitats (McShane & Naylor, 1995), where they feed on drifting broken and/or degraded pieces of seaweed (Allen et al., 2006). Pāua take at least three years to reach maturity and 5-8 years to reach harvestable size (Gerrity & Schiel, 2023).

Pāua prefer habitats that are wave exposed and waters that are highly oxygenated. Juvenile pāua graze on algal films on rocks, while larger pāua need drift algae.

Green-lipped mussels (*Perna canaliculus*)

Green-lipped mussels are a reef-building species that can form large aggregations in the intertidal zone to depths over 50 m (Jeffs et al., 1999; Powell, 1979). They are found in coastal areas throughout New Zealand, from Northland at Ninety-mile beach to Southland in parts of Bluff, and were historically reported in dense beds of up to 100 m^2 in central and northern New Zealand (Flaws,

1975; Hickman et al., 1991; Paul, 2012; Stead, 1971a, 1971b). Adult mussels, can grow to over 240 mm in length (Stead, 1971a, 1971b), can be found on a variety of substrates, including soft-sediment and rocky shorelines. They are filter feeders and can filter up to 350 litres per day.

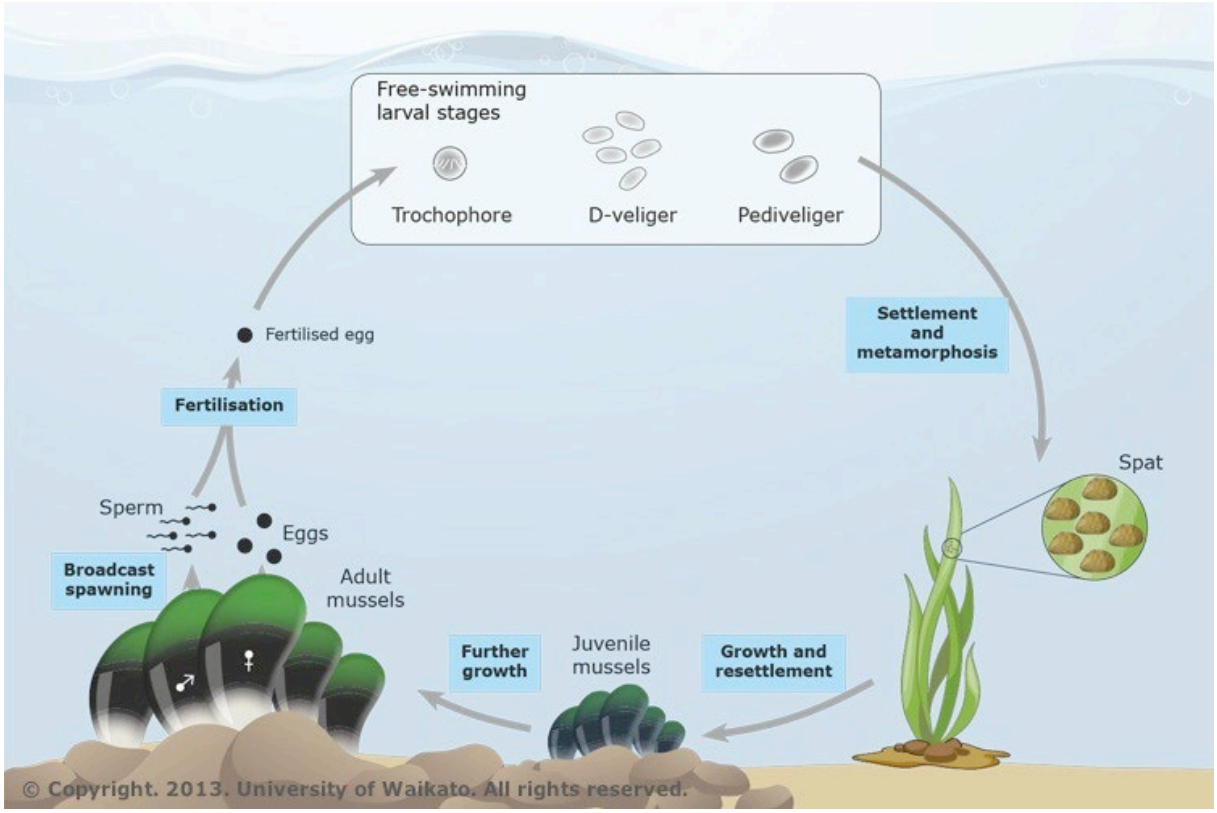


Figure 17: Life cycle of the green lipped mussel, *Perna canaliculis*. Credit: University of Waikato. Mussel life cycle — Science Learning Hub

Green-lipped mussels are broadcast spawners, like many other shellfish, where the females release eggs and males release sperm into the water column (Jenkins, 1985)(Figure 17). Once the eggs are fertilised the mussel larvae is free-swimming and feeds while in the water column, becoming a pediveliger in 4-6 weeks (Buchanan & Babcock, 1997)(Figure 17). Mussels undergo two stages of settlement known as primary and secondary settlement. As a pediveliger, mussel larvae usually undergo primary settlement onto macroalgae, with the preference for filamentous macroalgae (Alfaro et al., 2006; Buchanan & Babcock, 1997). Pediveligers rarely settle directly into adult mussel beds, possibly due to their small size and the risk of being filtered by the adult mussels (Alfaro, 2006; Jeffs et al., 1999). This primary settlement period onto macroalgae is a critical life stage. The next step in the mussel life cycle is secondary settlement where the young mussels, sometimes referred to as spat, move from their primary settlement substrate into a mussel bed or other secondary settlement substrate (e.g., shells, rocks, wood, etc.) (Buchanan & Babcock, 1997) via two possible forms of movement, either mucous drifting or crawling using their foot. Mussels are highly mobile throughout all life stages and can continue to move as adults using their byssus threads (Jeffs et al., 1999).

Cockles *(Austrovenus stutchburyi)*

Cockles are common shellfish found in estuaries and harbours around Aotearoa-NZ. They are mostly found in the intertidal, but occasional populations exist subtidally (e.g. Tory Chanel). Like pāua and

green-lipped mussels, they are broadcast spawners, which requires synchronisation in the timing of release of eggs and sperm by females and males, respectively (Figure 18).

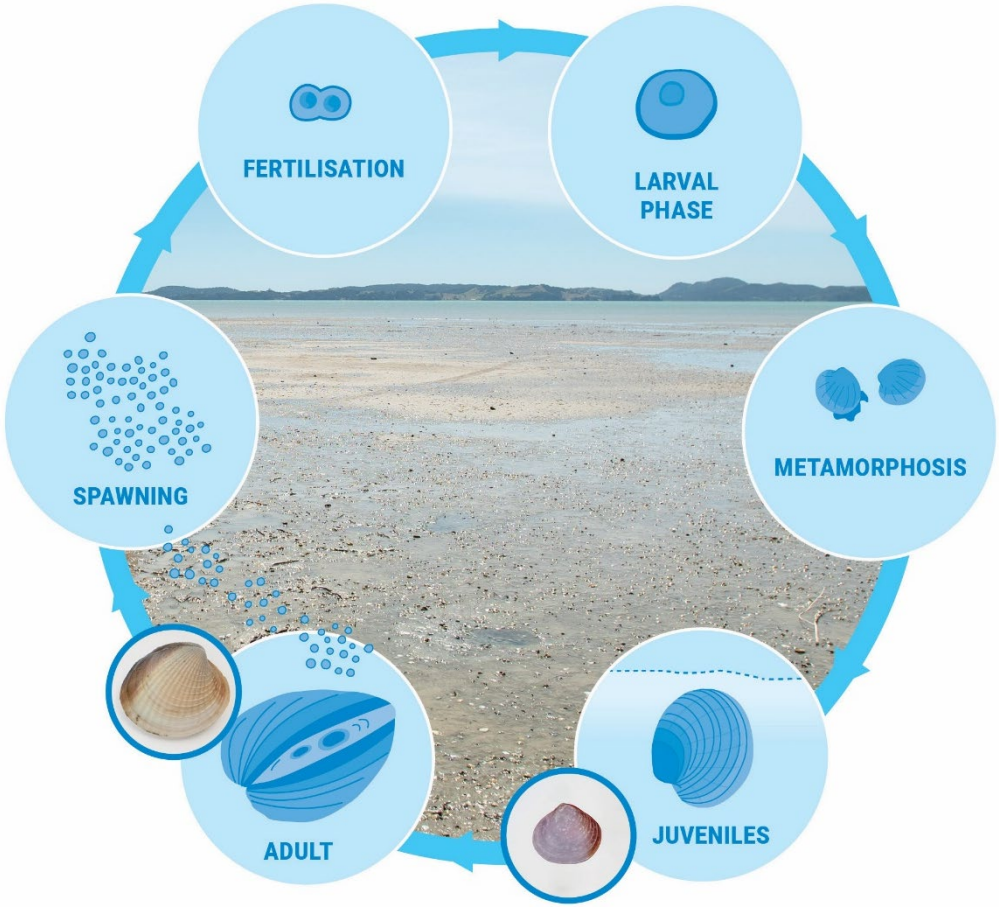


Figure 18: Life cycle of the New Zealand cockle, *Austrovenus stutchburyi*. (Adapted from NIWA, 2021).

Cockle spawning usually occurs in late summer (Larcombe, 1971), but the timing varies with location, and even within a region. For example, in four different estuaries in Canterbury, females spawned in summer only, in winter and then again in spring or summer, or intermittently throughout the year (Adkins et al., 2016). Their larvae drift and feed in the water column while developing, for around three weeks (Marsden & Adkins, 2010; Stephenson & Chanley, 1979) depending on temperature and food availability. They become mature at approximately 18 mm in length, regardless of age (although usually around three years old) (Adkins et al., 2014), and can live for >20 years. Growth rates and maximum sizes are strongly location dependent, with cockles considerably larger and slower growing in the South Island compared to the North Island.

Cockles are mobile as small juveniles, positioning themselves at the surface of sediments so that they can be moved with bedload transport (movement of sediments with currents; Lundquist et al., 2003). Once they are adults, they move by crawling, > 1 m per tidal cycle (Hewitt et al., 1997).

Cockle growth is influenced by sediment type (they prefer sandy over muddy substrates, with a preference for habitats with <12% mud; Thrush et al., 2003) and level on the shore (cockles grow larger lower on the shore as adults; Dobbinson et al., 1989; Stewart & Creese, 2002). However, multiple stressors, including salinity, nutrients, suspended sediments, contaminants, water and air temperature and wind (De Luca-Abbott, 2001; De Luca-Abbott et al., 2000; Marsden, 2004; Norkko et

al., 2006; Stewart, 2005), are responsible for the major differences between sites in population density and structure (Adkins et al., 2014).

Dispersal and mobility

There may be biological and environmental bottlenecks (habitat limitations) that affect recruitment and thriving populations. Shellfish may produce larvae that spend days to weeks in the water column.

Environmental bottlenecks could include, for example, (i) currents that transport larvae away from your area of interest to a location where the habitat is less suitable for their growth and survival, (ii) high suspended sediment concentrations which damage larvae during this delicate development stage, (iii) surface sediments deposited at the seafloor or smothering hard substrates that prevent successful settlement by metamorphosing larvae. In addition, environmental stressors can result in shellfish needing to use more energy to survive, leaving less available for growth and reproduction and, ultimately, persistence and survival.

Mobility of shellfish, particularly during the days-weeks spent in the water column as larvae, is an important consideration. Shellfish may also be quite mobile as small juveniles and/or adults (e.g., cockles, wedge shells, pipi, scallops;Cummings & Thrush, 2004; Handley et al., 2016; Hooker, 1995; Lundquist et al., 2003). For many harbours and estuaries, hydrodynamic models exist of water circulation which can be used to predict where a larvae might end up. With this information these areas can be proposed for protection (see Section 4, Legislation), or activities can be carried out there to improve the retention and survival of spat and juveniles (e.g. by adding shell to build reef that spat can settle on, as in the mussel restoration project (see above). Alternatively, reseeding can be focussed in areas with suitable habitat where the spat won't get to naturally.

3.4 Evaluating success

What does success look like? It depends on the goals and the outcomes that you are wanting from the activities. It is important to ensure that a suitable monitoring approach is designed, in order to learn from restoration projects. The measures used for evaluating and determining success can be largely based on the goals of the rehabilitation or restoration initiative.

Different environmental factors and conditions make locations more or less suitable for the species of interest. There are a number of summaries already available that provide useful guidance on what factors are important to monitor, and the methods for doing so (e.g., see Cummings & May, 2009; Roberts et al., 2023, Otago Uni cockle monitoring, other guides). Below we provide a brief explanation and some specific examples.

3.4.1 Step 1. Baseline evaluation.

A baseline evaluation is an initial survey that provides a benchmark/starting point that you can use to evaluate the effects of your restoration/rehabilitation efforts. It should include things like:

- Habitat description (e.g. sediment type, food availability, site exposure and stability, structure, water quality)
- Biodiversity (above and below seafloor)
- Shellfish density (abundance per unit area) and size

Because it is only a snapshot of your site at a moment in time, and because site conditions and species abundances can vary throughout the year (e.g. with the seasons), you would ideally repeat this at different times of the year. When you re-evaluate after your activities, make sure to repeat surveys at a similar time of year to the initial surveys.

This can also be a great way to initially evaluate and decide on the best areas, season and sites before implementing activities.

3.4.2 Step 2. Monitoring and evaluating success

Consistency of sampling is key to comparability of survey data and population estimates over time. To that end, sampling should be standardised as much as possible. For example, use the same sized quadrats and sieves, use markers or GPS to accurately re-locate sample sites, accurately measure the shellfish in the same dimension and using callipers rather than rulers (Figure 19).

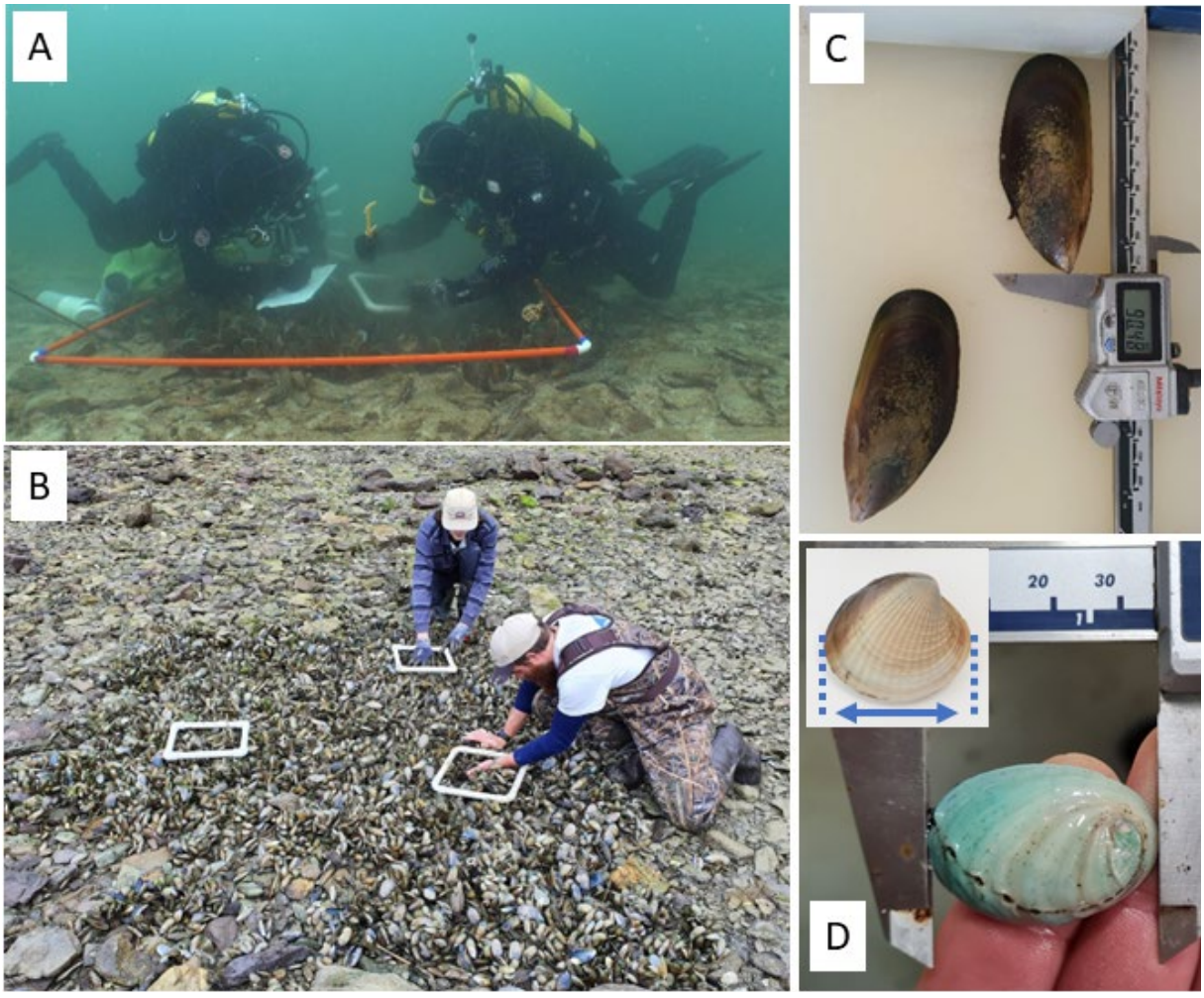


Figure 19: Monitoring mussel transplants. A. subtidal mussel transplants in Te Hoiere/Pelorus Sound (Louis Olsen, NIWA), B. intertidal mussel transplants in Te Hoiere/Pelorus Sound (Emilee Benjamin, UoA), Standard shell length measurements for C. green lipped mussels, E. pāua and cockles (inset).

Practical example: Mussel (kuku) beds in Te Hoiere/Pelorus Sound, Marlborough Sounds.

In 2019 a restoration initiative with the goal of rehabilitating mussel beds on the seafloor was started in Te Hoiere/Pelorus Sound. As mussel beds were severely overharvested in the early 1970's (Handley, 2015; Paul, 2012; Stead, 1971b), it was important to firstly understand if the seafloor habitat was suitable for survival of transplanted mussels from aquaculture. The first initiative was to test habitat suitability in five locations in Te Hoiere/Pelorus Sound that, prior to overharvesting, had supported dense mussel beds (Benjamin et al., 2023). Four tonnes of green-lipped mussels were deployed across the five locations, creating three 1.5 × 1.5 m plots of mussels at each location, combined with equivalent marked "control" plots. Over the following two years each location was monitored every 4-7 months (six occasions) to evaluate success. The following measurements were made:

- Mussel survival – Measured by counting mussels alive and dead within a fixed area and using that to estimate mussel survival over time (Figure 20a). In this example, a quadrat of 0.25 × 0.25 m was placed into each mussel plot three times at every sampling event.
- Mussel density – A count of live mussels within a fixed area (number of mussels/m^2).
- Mussel growth – Measured by collecting a sample of mussels and measuring the length. In this example, five mussels were collected from each plot at each sampling event.
- Mussel condition – This is a metric to understand the health of the mussels and is measured by collecting a sample of the mussels and drying out the flesh and shell (Lucas & Beninger, 1985). (Figure 20b).
- Area of the mussel plot – The length and the width of each mussel plot was measured to help understand how the mussel plot was moving over time.
- Juvenile mussel recruitment – Measured by looking for any smaller mussels (typically less than 30 mm) in a fixed area.
- Eleven-armed sea star abundance, *Coscinasterias muricata* – This sea star (Figure 21) is a common predator of mussels across New Zealand, (e.g., Paul-Burke & Burke, 2013). Sea star abundance can be measured in a variety of ways, but in this example the sea stars were collected from each mussel plot, counted and subsequently translocated 1 km away, at each sampling event. (Figure 20c).

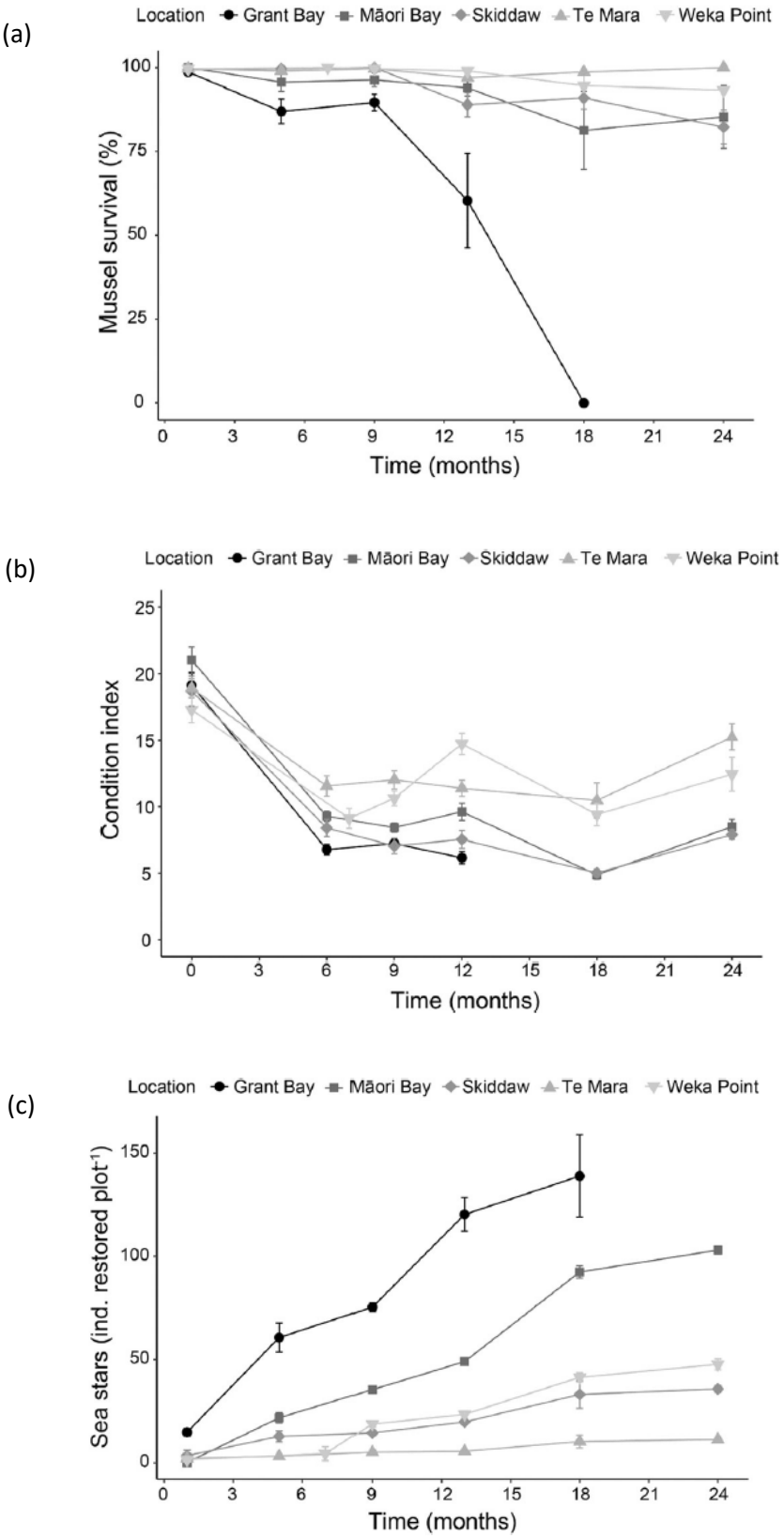


Figure 20: Monitoring mussels over a two-year period after transplantation onto the seafloor in Pelorus Sound/Te Hoiere - (a) mussel survival, (b) mussel condition, (c) sea star abundance. Graphs are from (Benjamin et al., 2023). Mussel survival was high at four of the five sites, condition showed similar seasonal variation across sites over time. Seastar abundance increased over time and was the likely cause of the high mortality at Grant Bay.

Figure 21: Eleven-armed sea star eating a mussel in Pelorus Sound/Te Hoiere. (Sean Handley, NIWA).

Figure 22: A transplanted mussel reef in Pelorus Sound/Te Hoiere. Mussels became colonised with epifaunal organisms, such as sea cucumbers and cushion sea stars, and cryptic pelagic triplefin fish (Louis Olsen, NIWA).

In addition, a biodiversity analysis was performed twice over the two-year period at 5- and 13-months post transfer of mussels to the seafloor at four of the five locations (E. D. Benjamin et al., 2022). This was to understand the ecosystem service mussels provide including provision of habitat for other organisms and how that might differ across the four locations. The following levels of biodiversity were monitored:

- Infauna (organisms, such as worms, living within the sediment)- For assessing infauna it is common to take core samples that are pushed into the sediment. Then the samples are sieved and the infaunal organisms are taken out, identified, and counted. Three cores were taken both within each mussel bed and in nearby "control" areas (a nearby area where mussels had not been added) to provide comparison. (Figure 23a).
- Epifauna (organisms, such as sea cucumbers, living on top of the sediment; Figure 22)- There are a few different ways to assess epifauna. In this study, video transects were taken by divers and then analysed by two individual people who identified and counted all organisms and algae in a fixed area. The video transects were taken on the mussel beds and in nearby control areas. (Figure 23b).
- Pelagic (organisms, such as fish, visiting or living inside the mussel beds)- For assessing pelagic fauna it is common to use underwater cameras. For this study, specialized cameras with extra battery packs were used to record the mussel beds and nearby control areas for 3.5 hours at two locations. (Figure 23c).

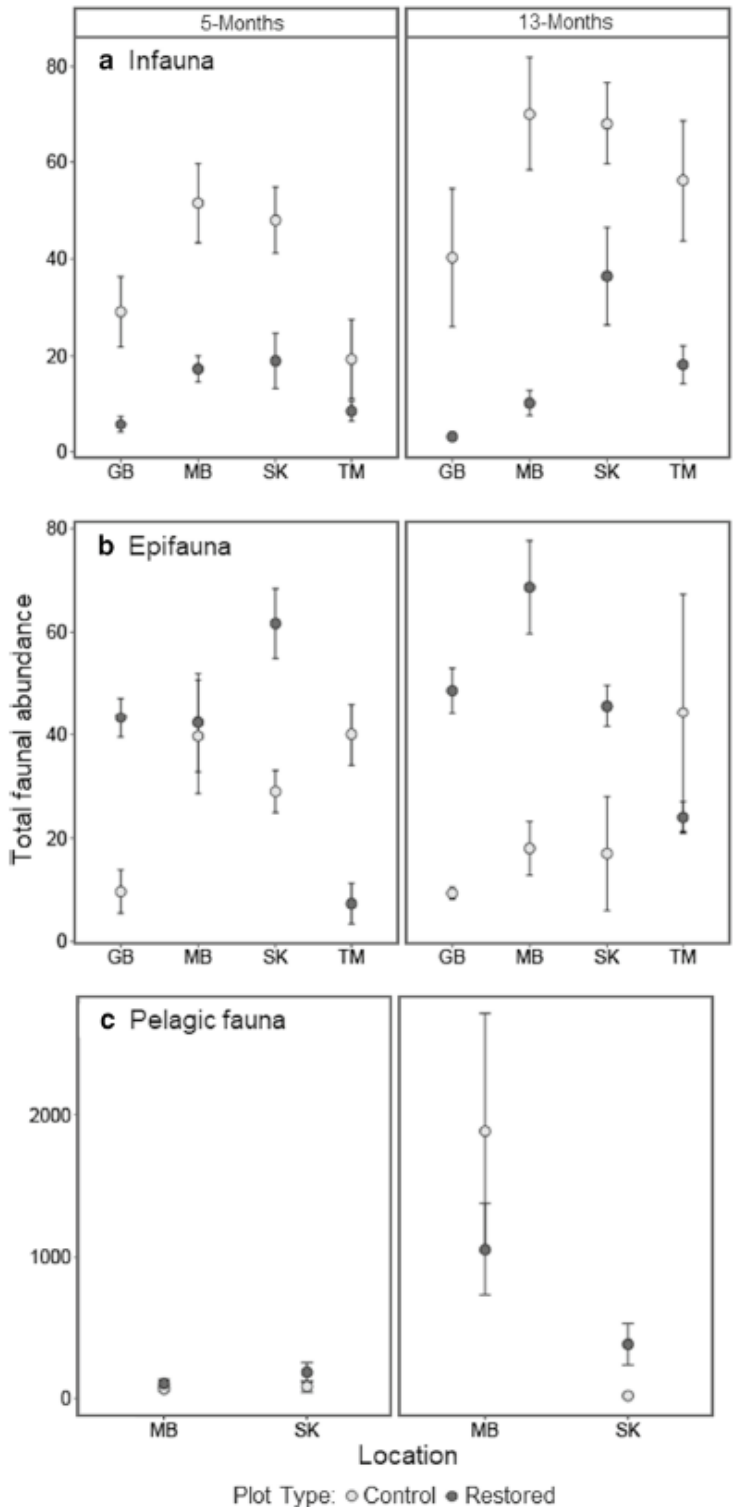


Figure 23: Abundance of infauna, epifauna and pelagic fauna on translocated mussels. Shown are average total abundance of (a) infauna, (b) epifauna, and (c) pelagic fauna on translocated mussels (dark grey) versus control areas (white) recorded at 5- and 13-months post transfer to the seabed. Locations are abbreviated Grant Bay (GB), Māori Bay (MB), Skiddaw (SK), Te Mara (TM), means are reported (± SE). Infaunal abundance was higher at the control areas, likely due to the sampling method being directly underneath the mussel clumps where the sediment is enriched by mussel biodeposits. Epifaunal abundance was higher on the mussel beds at three of the four locations and the diversity of organisms was higher at two of the four locations (not displayed here). Pelagic abundance was higher at one of the two locations and blue cod were observed 3.7 times more often on the mussels than in the control areas. Graphs and results are from Benjamin et al. (2022).

Example 2. Cockle beds (tuangi, tuaki) in Whangarei Harbour.

In 2007, an active intervention technique was used to enhance cockle beds on intertidal sandflats in Whangarei Harbour**.** This mahi was to trial methods for transplanting cockles, sourced from an area of naturally high densities within the harbour, onto two intertidal flats in locations that had seen decline in densities in the past decades. Around 6000 adult cockles were collected from MacDonald Bank in Whangarei Harbour, marked and transplanted to Takahiwai and Parua Bay within the harbour, creating multiple 60 × 60 cm plots at each location (Hewitt & Cummings 2013). The success of the transplants was monitored on four occasions over the following 12 months, to determine whether the densities of the adult cockles remained high and their physiological condition was retained, whether the transplants enhanced densities of other size classes of cockle and enhanced benthic macrofaunal species richness and diversity, and whether benthic macrofaunal community composition changed in the experimental areas relative to the control areas (without transplanted cockles).

- Sizes and densities of cockles – assessed by excavating 30 x 30 cm quadrats and counting numbers within each of 4 size classes (4-10 mm, 10-25 mm, 25-32 mm, >32 mm).
- Bivalve recruitment – measured by collecting core samples from each transplant plot (5 cm diam. 2 cm deep; sieved on 180 mm mesh) and counting numbers of post larval (<1 mm) and juvenile (1 to 4 mm) cockles.
- Macrofaunal abundance – measured by collecting multiple core samples from each transplant plot (15 cm diameter, 10 cm deep, sieved on 500 µm mesh)
- Sediment characteristics – measured by collecting surface sediment cores (2.6 cm diameter, 1 cm deep), to characterise sediment chlorophyll *a* (chl *a)*, organic content and particle size.
- Physiological condition of cockles at the transplant and the donor sites – determined based on a dry flesh weight to dry shell weight ratio; dry weights were determined by drying at 60°C to constant weight.

Within the first year of the transplants, densities of transplant sized individuals and smaller adults were enhanced at both sites (Figure 24) (Hewitt & Cummings, 2013).

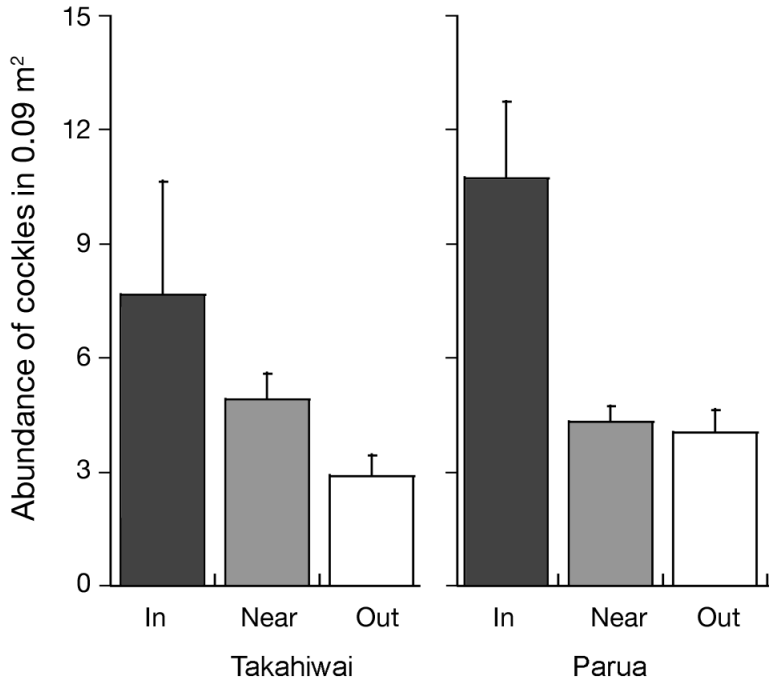


Figure 24: Average (+ SE) abundance of adult cockles (25-32 mm) found in experimental areas 1 year after transplanting. Shown are cockles found within the original transplanted plots (In), within 1 m of the original transplanted plots (Near), or > 1 m from the original transplant plots (Out). (from Hewitt & Cummings 2013).

A set of helpful hints guidelines aimed at community groups (Figure 25) were developed as part of this project, that can be used as is or adapted to the particular project in question.

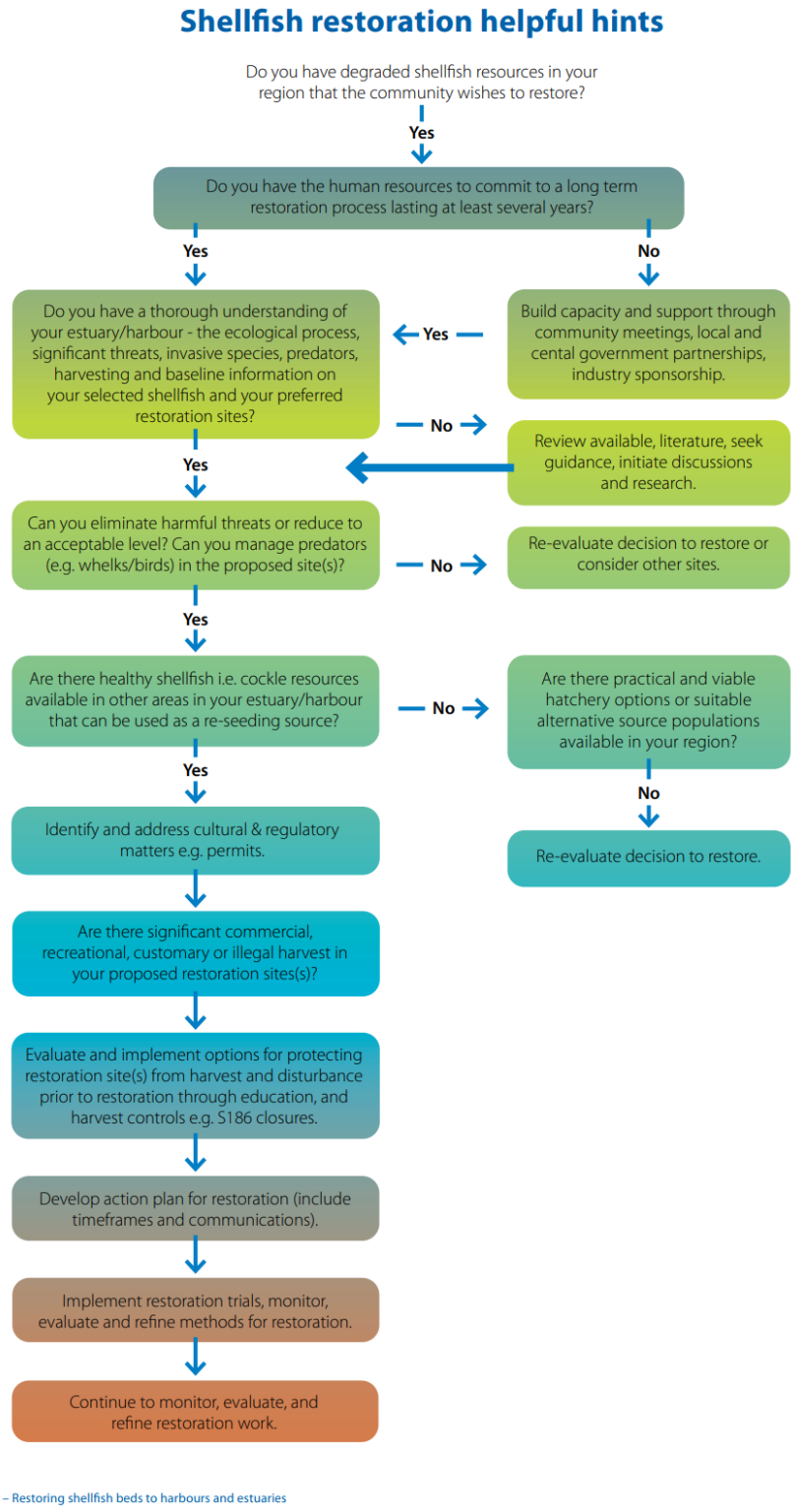


Figure 25: Shellfish restoration helpful hints. From Cummings & May 2009.

3.5 Legislation

Legislation and policy settings are crucial enablers or inhibitors to undertaking rehabilitation in the marine environment. Critical aspects, when well addressed, can for instance:

- Help prevent activities that could further harm the marine ecosystem.
- Designate specific areas for protection, ensuring that critical habitats for shellfish are preserved and restored.
- Direct funding and resources towards rehabilitation projects ensuring sufficient financial and human resources are available.
- Ensure sustainable practices in aquaculture and fisheries and that shellfish populations are not over-exploited and have the opportunity to recover and thrive.
- Facilitate the involvement and ownership of rehabilitation initiatives of various stakeholders, ensuring efforts are collaborative and consider diverse perspectives and knowledge.
- Mandate regular monitoring and assessment of shellfish populations and their habitats, to help monitor the progress of rehabilitation efforts and allow for adjustments based on scientific data and outcomes.
- Promote adaption and appropriate resilience strategies to address the actual and potential impacts of climate change, such as ocean acidification and rising sea temperatures, which can adversely affect shellfish.

Legislation and policy settings should provide the necessary structure, support, and regulation to ensure that shellfish rehabilitation efforts are successful, sustainable, and beneficial for the marine environment and communities.

Legislation in Aotearoa New Zealand

Aotearoa New Zealand has a complex regulatory environment, where several different pieces of legislation protect the marine environment and manage use of its resources (Figure 26).

While there are a number of sectorial-based legislative and policy settings for protecting indigenous biodiversity, there is little focus on rehabilitation and restoration. These variously and broadly direct management and decision-making to: 'allow for utilisation within environmental limits' and to 'protect and maintain indigenous biodiversity'. Much of our existing legislation was developed in the paradigm of testing and managing for the adverse (or harmful) effects of human activities to the wider environment. When the same tests are applied to activities that seek to improve the health of those environments, they become problematic and unnecessarily inhibiting; they are not fit for purpose in that context.

Current implementation of Aotearoa's collective biodiversity policy at finer scales (e.g. localised geographically and jurisdictional based) centre on the **protection of *existing* significant** areas of biodiversity. Apt examples (in the context of this report) can be found in Marlborough District Council's Ecologically Significant Marine Sites and Fisheries New Zealand's protection of habitats of *particular* significant for fisheries management. And such a focus, given Aotearoa's (and the Marlborough Sounds) declining marine health (MDC, 2015; MfE & Stats NZ, 2022), essentially ignores the legacy of generations of damage that has already occurred, and often continues to occur (e.g. Urlich and Handley 2020b). In fact, damaging activities are often directed to occur in such areas.

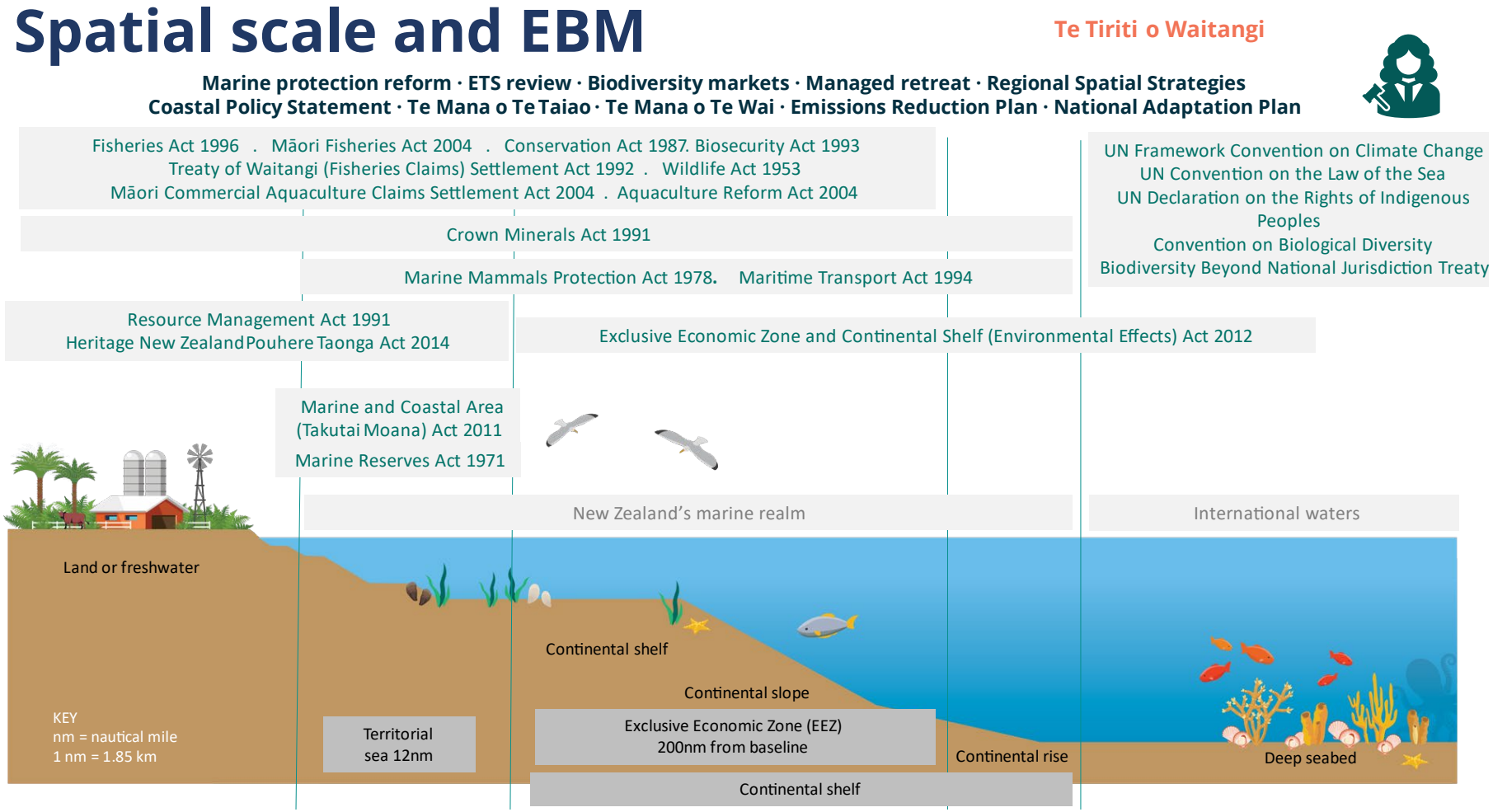


Figure 26: Demonstration of complex regulatory environment. Key pieces of legislation that protect the marine environment and manage use of its resources and where they apply (Macpherson & Jorgensen, 2024)

Need for rehabilitation policies

While protection policies are essential for preventing further damage, the development of rehabilitation policies would better support active marine rehabilitation of degraded marine environments and is something that should be considered. Environmental problems that can arise from this protection centric framework include:

- Limited recovery. While protection policies can prevent further degradation, they do not actively promote the recovery of already damaged ecosystems.
- Missed opportunities for restoration. Rehabilitation policies provide structured approaches to restore ecosystems, reintroduce species, and repair habitats. Without these policies, opportunities to actively restore the environment are missed, potentially leading to prolonged periods of ecological imbalance.
- Continued decline of ecosystem complexes and ecological services. Protection policies alone are unlikely to restore these where they are already lost or go unrecognised (e.g., “shifting baselines”; Pauly, 1995).
- Continued loss of biodiversity as broader ecosystem functionality and connectivity is no longer sufficient to maintain this.
- Lack of holistic approach where both protection and rehabilitation are required to restore ecological health.

Other problems arise also through a lack of policy direction and matters that can frustrate marine rehabilitation and restoration initiatives. In Aotearoa New Zealand, these include:

- Hurdles in navigating the complex regulatory environment. For instance, obtaining the necessary permits, conflicting policy and priorities between different jurisdictions and meeting compliance requirements (that can also differ between different jurisdictions) can be time-consuming and costly.
- Funding and resources to navigate the planning and consenting processes.

Addressing these challenges requires a coordinated approach that includes securing funding, fostering partnerships, enhancing scientific knowledge, engaging the community, and implementing supportive policies and regulations.

Creating fit for purpose marine rehabilitation policy for Aotearoa New Zealand would offer several benefits, addressing existing challenges and facilitate more effective (and efficient) rehabilitation efforts.

While there is no specific policy direction in Aotearoa New Zealand to support rehabilitation and restoration efforts, existing policy does not prohibit such initiatives. Rather consenting, permitting and compliance requirements, being designed to manage the adverse effects of activities in the marine environment that seek to utilise resources, frustrate activities that work to give back to Tangaroa.

Considerations and regulatory requirements for undertaking rehabilitation activities

What do you need to do?

Early in the process, contact the Council with jurisdiction over the area(s) the initiative will occur in, as well as the Ministry for Primary Industries (and/or Fisheries New Zealand) to determine the regulatory requirements that will need to be met in order to carry out the activities.

We have received guidance from both Fisheries New Zealand and the Marlborough District Council (relative to the Fisheries Act 1996 and the RMA 1991, as given effect through the Marlborough District Council's 'Proposed Marlborough Environment Plan') regarding considerations and regulatory requirements for undertaking rehabilitation activities.

Ministry for Primary Industries/Fisheries NZ

FNZ are supportive of restoration in our coastal marine areas, and can be contacted for information or to see how they can help your project info@mpi.govt.nz (Subject: Fisheries Management). As part of any collaboration, FNZ can share knowledge, research, information, data, and GIS mapping to help with restoration project planning (e.g. https://fs.fish.govt.nz/Page.aspx?pk=91).

There will be different requirements depending on the details of the rehabilitation project, including location/restoration type/risks etc. Chosen species, restoration areas and methods will determine the legislative and/or regulatory requirements. Some of the requirements that will need consideration during the planning stage, including the length of time any permits/permissions may take to obtain are provided below.

The purpose of the *Fisheries Act 1996* is to provide for the utilisation of fisheries resources while ensuring sustainability. The Act also provides Fisheries New Zealand (FNZ) with the tools to protect habitats, ecosystems and protected species from any adverse effects of fishing.

3.5.1 Tools available under the Fisheries Act

Tools that could assist with restoration activities include (but are not limited to):

Sustainability measures - Section 11

https://www.legislation.govt.nz/act/public/1996/0088/latest/DLM395397.html?search=qs_act%40bill%40regulation%40deemedreg_fisheries+act_resel_25_h&p=1

- The Minister may, from time to time, set or vary any sustainability measure for 1 or more stocks or areas. Sustainability measures may relate to catch limit (including a commercial), size, sex, or biological state of any fish, aquatic life, or seaweed of any stock, areas, fishing methods, fishing season, or fishing method.

Total available catch - Section 13

https://www.legislation.govt.nz/act/public/1996/0088/latest/DLM395507.html?search=qs_act%40bill%40regulation%40deemedreg_fisheries+act_resel_25_h&p=1

- The Minister shall set in respect of the quota management area relating to each quota management stock a total allowable catch for that stock, and that total allowable catch shall continue to apply in each fishing year.

Special permits - Section 97

https://www.legislation.govt.nz/act/public/1996/0088/latest/DLM396952.html?search=qs_act%40bill%40regulation%40deemedreg_fisheries+act_resel_25_h&p=1

The Director-General of MPI may, on application, issue to any person a special permit for the purposes of education, investigative research, management of aquatic life, fishing trials and any other purpose approved by the Minister.

- For restoration currently the only relevant purpose will be Investigative Research. Special permits do not apply to customary fishing areas and activities.
- For community based projects there may be a special permit fee waiver, where the restoration would be in the public interest.

General regulations - Section 297

https://www.legislation.govt.nz/act/public/1996/0088/latest/DLM399599.html?search=qs_act%40bill%40regulation%40deemedreg_fisheries+act+1996_resel_25_h&p=1

The Governor General may from time to time, by Order in Council, make regulations for numerous purposes including controlling commercial and recreational fishing.

3.5.2 Customary Management Tools

(contact info@mpi.govt.nz, (Subject: Fisheries Management (Spatial and Cultural Teams)):

Mātaitai

https://www.legislation.govt.nz/regulation/public/1999/0342/latest/whole.html#DLM297640

- Mātaitai are established on a traditional fishing ground for the purpose of recognising and providing for customary management practices and food gathering. Tangata Whenua can restrict or prohibit fishing non-commercial fishing in mātaitai reserves by making bylaws. Generally there is no commercial fishing within mātaitai reserves.

Taiāpure

Part 9 of the Fisheries Act sections 174 to 186:
https://www.legislation.govt.nz/act/public/1996/0088/latest/DLM394192.html?search=qs_act%40bill%40regulation%40deemedreg_fisheries+act+1996_resel_25_h&p=1&sr=1

- Taiāpure can be established in estuarine or littoral coastal waters that have customarily been of special significance to any iwi or hapū either – (a) as a source of food; or (b) for spiritual or cultural reasons. Taiāpure allow for commercial and non-commercial fishing to occur. Taiāpure management committees can recommend regulations such as new daily bag limits for recreational fishing, size limits, and closures, to the Minister of Oceans and Fisheries. The regulations can only be made with respect to fishing, or fishing related activities within the taiāpure.

Temporary closures (formal rahui)

Section 186A and 186B of the Fisheries Act:

Section 186A Temporary closure of fishing area or restriction on fishing methods (for the North and Chatham Islands)
https://www.legislation.govt.nz/act/public/1996/0088/latest/DLM397974.html

Section 186B Temporary closure of fisheries (for the South and Stewart Islands)
https://www.legislation.govt.nz/act/public/1996/0088/latest/DLM397977.html

- These allow the Minister for Oceans and Fisheries or the Director-General of MPI (for the South Island), respectively, to temporarily close an area to fishing for one or more species, or to restrict a fishing method. Temporary measures apply to all fishing sectors.
- Anybody can ask for a temporary closure.

3.5.3 Biosecurity

Activities involved in restoration efforts can have the potential to introduce and spread non-indigenous species (marine pests, diseases, or parasites). The impacts of introduced marine species on New Zealand's native biodiversity and ecosystem services can be potentially devastating, so it will be important to consider these risks.

3.5.4 Resource Management Act (RMA)

Resource consents

Coastal permit - A coastal consent, or permit, may be required for a wide range of activities, including e.g. disturbance of foreshore or seabed and removal of sand, shingle, shell or natural material. Each local Council have their own Coastal/Environmental/Regional Plans. The rules, regulations, and bylaws may be different between each council/local area, and processing time for each local Council may also differ. Contact your local council for the area where you want to undertake restoration activities.

3.5.5 Examples

Below are some key considerations of how restoration activities could be achieved under fisheries legislation, along with some case study examples:

Is the restoration area within a gazetted rohe moana under customary fishing regulations?

https://www.mpi.govt.nz/fishing-aquaculture/maori-customary-fishing/customary-fisheries-management-areas-rules-and-maps/ (noting subject to change)

Yes Approach local tangata kaitiaki/tiaki early in the process to seek their feedback and support for the restoration activity.

Tangata whenua may be able to enable the movement of species within their rohe moana.

A list of iwi by local authority:

https://www.tkm.govt.nz/browse/

Customary Fishing regulations:

South Island Customary Regulations 1999-
https://www.legislation.govt.nz/regulation/public/1999/0342/latest/DLM296893.html

Kaimoana Customary Fishing Regulations 1998-

https://www.legislation.govt.nz/regulation/public/1998/0434/latest/DLM267987.html

If no rohe moana has been defined (and is therefore ungazetted), customary management tools such as Mātaitai are unable to be utilised.

No A special permit and/or a permit to relocate aquatic life will be required. Contact Fisheries NZ Special permit team at specialpermits@mpi.govt.nz

https://www.mpi.govt.nz/fishing-aquaculture/fisheries-management/how-to-apply-fisheries-special-permit/

Also Check proposed restoration area for any fishery restrictions (commercial/recreational/cultural)

Fisheries commercial fishing regulations: https://www.legislation.govt.nz/

https://www.legislation.govt.nz/regulation/public/2013/0482/latest/DLM3629901.html?src=qs

https://www.mpi.govt.nz/fishing-aquaculture/recreational-fishing/fishing-rules/

https://www.mpi.govt.nz/fishing-aquaculture/maori-customary-fishing/customary-fisheries-management-areas-rules-and-maps/ (noting subject to change)

Case study 1- Seagrass restoration in an estuary from existing meadow donation

A. Gazetted rohe moana or not? Contact tangata kaitiaki/tiaki or special permit team.

B. Consider biosecurity risks of any translocation of seagrass. Ensure translocation occurs as close as possible to the donor meadow. Do not relocate outside the donor estuary.

C. Contact local Council as may require resource consent to disturb the seabed.

Case study 2- Reseeding mussel using broodstock from mussel farm

A. Gazetted rohe moana or not? Contact tangata kaitiaki/tiaki if gazetted rohe moana. Contact aquaculture@mpi.govt.nz

B. Consider biosecurity risks of seed stock to wild stocks (see Biosecurity section above).

C. May involve Fish Farm Licence- https://www.mpi.govt.nz/fishing-aquaculture/aquaculture-fish-and-shellfish-farming/setting-up-a-land-based-fish-farm/ https://www.mpi.govt.nz/dmsdocument/3678-Guide-to-establishing-and-operating-a-marine-farm-in-New-Zealand

D. Contact local Council as may require resource consent to disturb the seabed.

Case study 3 – Shellfish restoration translocating juvenile/adult shellfish

A. Gazetted rohe moana or not? Contact tangata kaitiaki/tiaki or special permit team.

B. Consider biosecurity risks of any translocation of shellfish. Ensure translocation occurs as close as possible to the donor site. Do not relocate outside the donor local area.

C. Contact local Council as may require resource consent to disturb the seabed where cages etc might be used initially to protect relocated shellfish.

D. Will there be a requirement for future sustainable harvest?

Case study 4 - Passive restoration

Fisheries Management tools could be used for restoration and protection purposes: i.e. sections 11, 13, and 297 of the Fisheries Act and *Fisheries (Amateur Fishing) Regulations 2013*

Marlborough District Council

Marlborough District Council's requirements for carrying out restoration work are outlined below.

The Proposed Marlborough Environment Plan (PEMP), a combined regional policy statement, regional coastal plan, regional plan and district plan, was publicly notified in 2016. The Plan enables and guides the use, development and protection of Marlborough's natural and physical resources, including indigenous biodiversity and the coastal marine area. Following the hearing of submissions and further submissions, a decision on the Plan was publicly notified in February 2020. The Appeals Version of the PMEP can be found here: https://www.marlborough.govt.nz/your-council/resource-management-policy-and-plans/proposed-marlborough-environment-plan/decisions-on-the-pmep/appeal-process/appeals-version-of-the-pmep

The Plan places an emphasis on restoration. Objective 4.3 recognises the impact of past resource use in degrading the ecological, physical, cultural qualities and amenity values of the Marlborough Sounds and sets an objective of enhancing those qualities and values to restore and rehabilitate the unique character of the Marlborough Sounds. Similarly, Objective 6.2 seeks to promote the restoration of the natural character of the coastal environment. The potential for restoration of natural character is a matter that can be considered by decision makers on individual resource consent applications (Policy 6.2.5), while Council encourages and supports iwi, industry, landowners and the wider community in their own efforts to restore the natural character of the coastal environment (Policy 6.2.8).

It is possible that some activities involved in restoration efforts trigger the need for resource consent under the RMA. The following activities are currently regulated in the coastal marine area under the RMA:

- Reclamation or drainage
- Erection, placement, alteration, extension and removal of structures
- Disturbance of the seabed and foreshore
- Deposition on the seabed or foreshore
- Disturbance of plants or animals or their habitats
- Introduction of exotic or introduced plants

Where restoration efforts involve one or more of the above, those proposing to undertake the restoration activity should consult with the rules of the relevant regional coastal plan to establish whether the activity can be undertaken without resource consent (a permitted activity), requires a

resource consent or is prohibited. In Marlborough those rules are predominantly found in Volume 2, Chapter 16 of the PMEP.

Practical example

Mussel (kuku) deployments in Marlborough Sounds (Benjamin et al., 2022)

To undertake green-lipped mussel transplants from a mussel farm to the seabed in the Marlborough Sounds for rehabilitation in 2021, two different types of permits were needed. The first was a resource consent from Marlborough District Council, and the second was a permission variation from the Ministry of Primary Industries (MPI) Biosecurity New Zealand under Section 52(d) of the Biosecurity Act 1993. The processes involved in obtaining these permits are described below:

1. A resource consent from the Marlborough District Council (MDC).

    A. This consent is a coastal permit to deposit a specific weight of live mussels into a specific area. The consent is granted for a specific amount of time.

    B. It is common to hire a coastal planning and resource consent consultant to help prepare the application and provide advice.

    C. In addition to the coastal planning aspects of the application there is a requirement to assess the potential environmental effects of the proposed plan (Figure 27).

    D. Letters of support from the community, iwi, and other stakeholders helps to support the resource consent application.

    E. Once the consent is approved there are specific conditions that are unique to each consent. For example, it is common to provide written or electronic advice to MDC of the planned start date of the deposition, and the location and extent of the deposition.

    F. In the case of this example, other conditions included a notification of the completion date of the field component of the associated scientific research and a copy of the report that documented the results of the scientific research associated with the deposition.

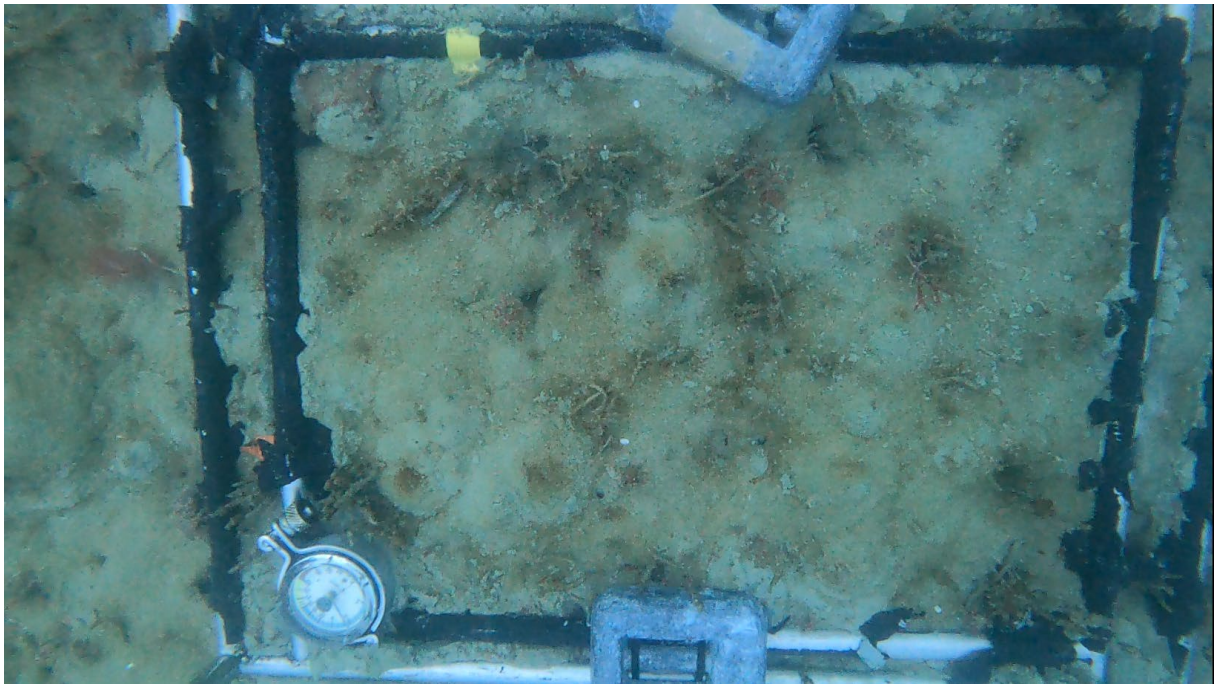


Figure 27: Photo quadrat taken to assess the seafloor habitat of the transplant location prior to applying for a resource consent It is important to determine that there is not existing biogenic habitat in locations targeted for rehabilitation, that may be damaged or destroyed during the rehabilitation activities. (Emilee Benjamin, UoA).

2. A permission variation from the Ministry of Primary Industries (MPI) Biosecurity New Zealand under Sections 52(d) of the Biosecurity Act 1993.

    A. This is a document providing permission to move mussels from an aquaculture farm to the seabed. The concern is that the mussels may have unwanted, invasive organisms associated with them that could be moved to the location being rehabilitated.

    B. For this example, the approval was sought to move mussels sourced from Pelorus Sound/Te Hoiere mussel farms to specific locations elsewhere within Pelorus Sound (locations matched those specified in the resource consent application to MDC).

        i. The unwanted organisms for the permission included *Undaria pinnatifida*, an edible seaweed also known as Wakame (Figure 28), *Styela clava*, an ascidian or sea squirt also known as the clubbed tunicate, and *Sabella spallanzanii*, also known as the Mediterranean fanworm.

        ii. *Undaria* and *Styela* are widespread throughout Pelorus Sound/Te Hoiere, but *Sabella* is not, making it a species that MDC is working hard to keep out of Pelorus Sound/Te Hoiere.

        iii. Sourcing mussels within the same region that the farms are in, reduces the concern regarding the spread or introduce unwanted, invasive, species.

    C. Once the permission is approved there are specific conditions on many aspects of the transfer of mussels that must be met. These include specific advice on the different aspects of the harvesting and deployment of mussels to ensure that there is no transfer of unwanted organisms. These include categories such as:

iv. Permitted persons

v. Written procedures

vi. Obtaining the mussels

vii. Transportation

viii. Deployment of mussels

ix. What to do if accidental or deliberate release occurs

x. Record keeping requirements

Figure 28: A mussel with *Undaria pinnatifida*, an unwanted, invasive, edible seaweed (Emilee Benjamin, UoA).

4 Conclusions and Recommendations

There are many instances and growing examples of communities and groups coming together to improve health of marine ecosystems through rehabilitation or restoration. Activities range from large scale coordinated initiatives to local scale community activities and may include (for example) minimising impacts of land- or marine- use on coastal environments, or actively enhancing shellfish beds.

All steps of this process can be challenging without adequate resources and skills, including access to appropriate and consistent scientific knowledge and expertise to understand marine ecosystems and species-specific needs. It is also important to understand that there are social and cultural differences where different groups may have varying levels of interest, knowledge, and capacity to participate in restoration efforts. There are many researchers around Aotearoa New Zealand who would be willing to share their information and experience.

Building local capacity for long-term management and maintenance of restoration projects is critical. By raising public awareness about the importance of shellfish rehabilitation and the steps involved, community members can be empowered to take on leadership roles and develop the skills needed for ongoing stewardship. This report has outlined the steps and considerations for groups embarking on such activities.

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Throughout this report we have used examples from other Sustainable Seas National Science Challenge projects, particularly to illustrate concepts that are important to ecosystem health and rehabilitation activities. We thank the talented researchers who have generated the summary figures that we have included here.

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Appendix A Te Kete Kaitiakitanga

National SCIENCE Challenges

SUSTAINABLE SEAS

Ko ngā moana whakauka

Te Kete Kaitiakitanga

Tools to enable kaitiakitanga & ecosystem-based management

May 2024

Report

Te Kete Kaitiakitanga

Tools to enable kaitiakitanga & ecosystem-based management

Introduction

Te Kete Kaitiakitanga is a simple toolkit which aims to provide guidance and means of assessment to support ensuring kaitiakitanga is appropriately provided for alongside EBM. It has been designed in collaboration with a range of partners for the use of agencies, organisations and iwi/hapū wishing to improve marine governance and management outcomes.

The opportunity

In Te Ao Māori, **Kaitiakitanga**[1] is variously defined but represents the obligation arising from a kin relationship to nurture or care for a person or thing. This obligation encompasses the need to care for and nurture not only physical but spiritual well-being. It is an inherited commitment that links mana atua, mana tangata and mana whenua mana moana (hereafter referred to as mana moana)[2],te ao wairua (the spiritual realm) with te ao turoa (the natural world, including humans) [3]. Kaitiaki are those that whakapapa to, and take responsibility for, a place and its natural elements. Kaitiakitanga is the active embodiment by humans in this role as kaitiaki.

The Sustainable Seas National Science Challenge has designed an **ecosystem-based management (EBM)**[4] approach tailored to our specific context here in Aotearoa New Zealand. This EBM approach is founded upon seven principles that provide a holistic and inclusive way to manage marine environments and the competing uses for and demands on them, as well as the ways they are valued. This EBM approach aims to allow various actors within the marine governance and management to better understand the implications of resource management decisions and manage the interface between land and sea more effectively.

Given the synergies between kaitiakitanga and EBM, there is a real opportunity to achieve enhanced marine governance and management outcomes by establishing the conditions that can support the equitable application of either or both ethics of care.

Te Kete Kaitiakitanga

Te Kete Kaitiakitanga is a simple toolkit designed to enable and enhance kaitiakitanga and EBM across the whole marine governance and management system.

Te Kete Kaitiakitanga has been developed within a three-year Sustainable Seas research project involving extensive work with kaitiaki and practitioners across the marine governance and management system and close co-development with a 15-member Project Advisory Group[5]. To characterise the marine governance and management system, our research utilised the *Three Spheres of Influence Framework*[6] as a basis for exploring how to enable an equitable, appropriate and enduring approach. This research also built on earlier work revealing the existence of numerous efforts to develop and

[1] See Reference Material for a description of Kaitiakitanga

[2] For the purposes of this toolkit references to 'mana moana' emcompass mana whenua and recognises the mana, mandate, authority and obligations a particular grouping of tāngata whenua has in relation to place (land or marine) and the ecosystems, taonga (gifts) and resources within.

[3] Selby et al (2010) p1 [Quoted in Hui-te-ana-nui report p104]

[4] See Reference Material for a description of EBM

[5] The Project Advisory Group members are identified in the Mihi at the end of this document

[6] Proposed by Matike Mai Aotearoa: The Independent Working Group on Constitutional Transformation (2016) made up of Māori scholars and practitioners and by thorough engagement with iwi and hapū (refer to their report here).

implement a more holistic and integrated Aotearoa-specific approach. It noted that many of the principles of EBM are already in practice, though only a handful demonstrated the application of all seven principles of EBM.

However, it also showed that the current system does not equitably provide adequate conditions to enable kaitiakitanga alongside EBM. Mana Moana have unique connections, a range of rights and interests, and hold deep, placed-based knowledge invaluable to understanding and providing for more effective marine governance and management. The research identified that activating a holistic, Aotearoa-specific approach encompassing kaitiakitanga and EBM required a real focus on enabling kaitiakitanga. If successful this has significant potential to achieve greater positive impacts for people and place through stronger, deeper connections with local ecosystems and our moana.

Te Kete Kaitiakitanga, therefore, aims to provide guidance and means of assessment to support ensuring kaitiakitanga is appropriately provided for alongside EBM. Applied as a package authentically and with genuine intention to honour the integrity of kaitiakitanga, Te Kete Kaitiakitanga offers a framework for transformative change.

The toolkit

Te Kete Kaitiakitanga comprises three simple tools:

- ***E Toru Ngā Mea*** – information to advise and help users gain an understanding of the critical elements required for Mana Moana involvement in marine governance and management.
- ***Mahi Tūhonohono*** – guidance to support users to provide for those critical elements to the necessary extent.
- ***Te Tiriti Relationship Enhancer*** – an assessment tool that enables users to evaluate their organisational approach to implementing marine governance and management in a way that provides equity of opportunities and outcomes across the socio-ecological and cultural seascape.

All three tools are centered around relationships, transparency and accountability. They aim to support equity and opportunity in the marine governance and management system - a system largely founded upon western approaches, structures, institutions, and knowledge. The tools enable users to explore relationships, knowledge and approaches founded in te ao Māori that offer the opportunity to enhance the well-being of people and the ocean through kaitiakitanga and EBM. In particular they aim to support making greater space for te ao Māori, particularly rangatiratanga (Māori leadership), mātauranga (knowledge and knowledge making), and tikanga (best practice).

Who should use this toolkit

Te Kete Kaitiakitanga is designed to support and enable place-based practitioners (e.g. iwi/hapū kaitiaki, community-led conservation groups etc), policymakers, and others engaged in marine governance and management. This includes Mana Moana, central and local government agencies, business entities and communities. Essentially, users from any part of the system can adopt and apply the tools in slightly different ways to achieve the best outcomes. They can assist users in equally valuing and equitably applying both ethics of care – kaitiakitanga and EBM.

How to use the toolkit

The tools within Te Kete Kaitiakitanga should be engaged sequentially. Users start with an internal inquiry through *E Toru Ngā Mea*, transitioning to an external outreach phase through *Mahi Tūhonohono*, and then to an evaluative phase focused on transparency, accountability and continuous improvement through *Te Tiriti Relationship Enhancer*.

The following sections provide an overview of the tools, with step-by-step guidance for specific users. Links to a range of Sustainable Seas and other documents and information is included at the end of this toolkit to support greater user understanding of kaitiakitanga, EBM and the application of both.

1: E Toru Ngā Mea

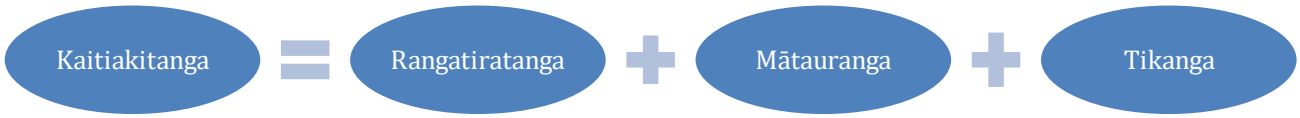
Understanding the critical elements of kaitiakitanga

E Toru Ngā Mea[7] – literally meaning 'three things' - is a simple but powerful formula comprising three te ao Māori principles necessary to activate and enable kaitiakitanga in a marine governance and management context.

Common challenges or issues relevant to enabling kaitiakitanga emerged through our research around three key themes:

- Rangatiratanga | Authority, agency and leadership
- Mātauranga | Knowledge and knowledge-making
- Tikanga | Best practice

We found that enabling kaitiakitanga relied on the application of these three themes or principles, that they were interconnected and interdependent, and that where possible needed to be enabled simultaneously to be truly effective.



The formula above must be applied within the context of Mana Moana as they are the only ones who can determine and define the appropriate authority, knowledge, and practices necessary for marine governance and management within a kaitiakitanga approach. In other words, identifying who has rangatiratanga; what mātauranga exists and is relevant; and what practices are applied and followed – can only be defined by Mana Moana in the context of their people, place, time and space. Such considerations include biophysical, cultural, socio-cultural and political factors, and collectively, determine appropriate scale/s (i.e. iwi, hapū, whānau, uri, pan-tribal or collective).

When used in this way, *E Toru Ngā Mea* can guide and support upholding the integrity of Mana Moana involvement in marine governance and management. Conceptually, E Toru Ngā Mea helps us to recognise that there are multiple meanings and embodiments of kaitiakitanga, there is no simple definition or tick box guide. Using this formula can help to ensure that we ask the right questions and consider the critical principles which guide and help to enact a responsive and continually evolving kaitiakitanga.

[7] *E Toru Ngā Mea* is a well known waiata or song, often sung to inspire collaboration and community. The original waiata speaks of three important things – the principle of whakapono (belief and trust), tūmanako (hope), and aroha (love, respect and compassion). The tool is named after the waiata because our research has indicated that authentically enabling kaitiakitanga requires the three critical elements of rangatiratanga, mātauranga and tikanga.

Identifying interests and applying E Toru Ngā Mea

To use *E Toru Ngā Mea*, whether you are kaitiaki, community, government agency or other, it is important to identify who has interests and 'user rights' in relation to any prospective marine governance and management approach, and the extent they wish to be involved. We designed another simple tool (Fig. 1 below) to assist, based on recommendations by the Waitangi Tribunal regarding 'rights and interests' in its report *Ko Aotearoa Tenei* (2011:112).

The simple step of appropriately identifying who has rights and interests in a specific marine governance and management context is important. This tool can help get the basics right, from the start. It is designed to support a much needed paradigm shift for Aotearoa and deliver appropriate kaitiaki involvement and outcomes. The following sets of rights and interests are important:

- Control by Māori of environmental management in respect of taonga, where it is found that the Kaitiaki interest should be accorded priority;
- Partnership models for environmental management in respect of taonga, where it is found that Kaitiaki should have a say in decision-making, but other voices should also be heard; and
- Effective influence and appropriate priority to the Kaitiaki interests in all areas of environmental management when the decisions are made by others.

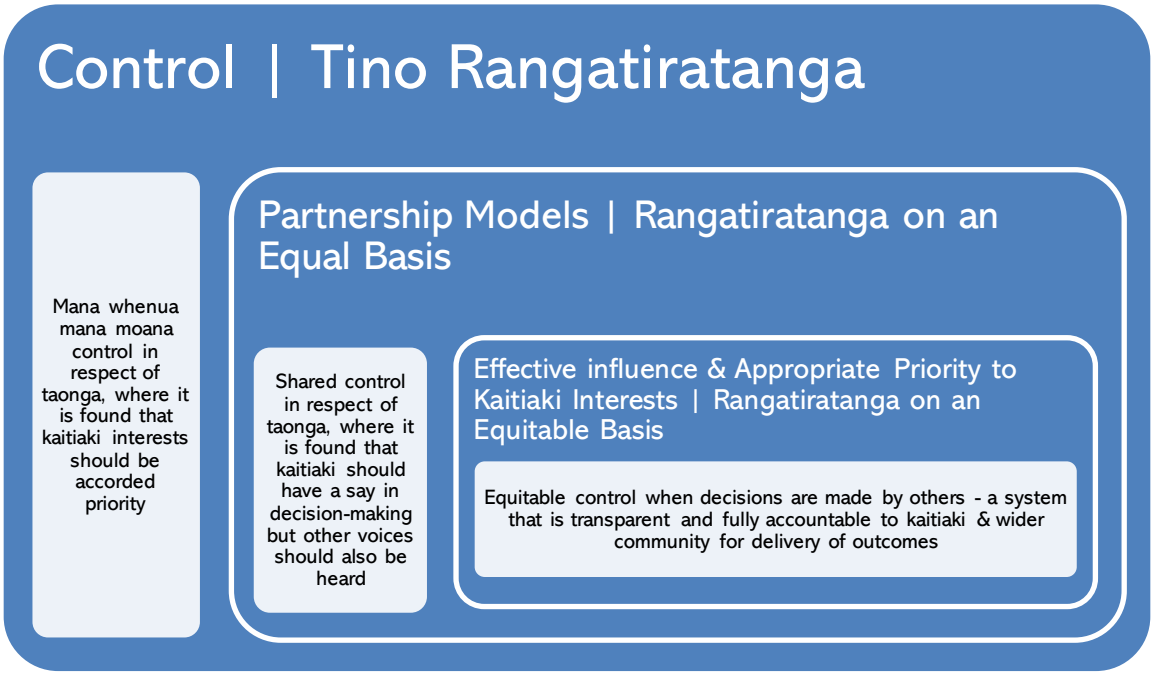


Figure 1: Rights and Interests Model for meaningful and equitable Aotearoa-specific, people and place-based marine governance and management.

The Tribunal noted that this approach "allows all legitimate interests (including the interests of the environment itself) to be considered against an agreed set of principles, and balanced case by case"

(Waitangi Tribunal, 2011:112). Transparency and full accountability to kaitiaki and the wider community are considered essential for the system's delivery of these outcomes.

The following checklists provide some guidance to support your early scoping and serve as valuable preparation for any engagement process.

Guidance for tāngata whenua	*Guidance for tāngata Tiriti (including agencies, organisations, community groups)*
Step 1: Contextualise things – gain an understanding of the marine governance and/or management context for you as tāngata whenua: 1. What area, and who is potentially affected? 2. Which taonga does it relate to? 3. Does it relate to the health & wellbeing of a wider ecosystem? 4. Is it a concern or issue? 5. Is it an opportunity? 6. How much of a priority is it?	**Step 1: Contextualise things** – gain an understanding of the marine governance and/or management context: 1. What area, and who, is potentially affected? 2. What scale/s of governance and management are important? 3. Who has Mana Moana status in the area? 4. Are they pre or post Treaty or Takutai Moana settlement? 5. What are the current structures, views and positions of Mana Moana in the area? 6. Are they likely to be interested or concerned? 7. Is it an opportunity? 8. Do you have a pre-existing relationship with any or all the relevant Mana Moana? 9. If not, how will you initiate engagement and begin to build an appropriate relationship? 10. Who are the local/regional authorities and what are their relationships like with Mana Moana? 11. Does it make sense to go through those local authorities first to obtain some background information so you can do some initial research?
Step 2: Capacity and capability – work out the level of capacity and capability you have to engage: 1. Does this context require others to be involved? 2. Can you make this happen, or will you need to get support? 3. Where can you get the required support to help and is it accessible to you?	**Step 2: Capacity and capability** – work out the level of capacity and capability you have to engage: 1. What cultural competency do you or your organisation have? 2. Have you set resource aside for engagement with Mana Moana? 3. If Mana Moana have initiated marine governance and management activities in this context, how informed and prepared are you to engage appropriately? 4. What can you bring to the table? 5. How much time do you have to commit to this and is it enough? 6. Where can you get additional support to help and is it accessible to you?
Step 3: User rights and interests – where does what you've discovered thus far fit into the 'rights and interests' model.	**Step 3: User rights and interests** – Mana Moana groups are likely to have different rights and interests, and although they are unlikely to want to engage in everything, there will be some marine governance and management initiatives

Confirm this with the necessary authorities e.g. iwi, hapū, whānau etc.	that they will have a strong interest in. They may even wish to lead or partner in the initiative. The 'rights and interests' model can help identify the level and extent of likely interest and will require some research to ensure a sound understanding. Ultimately it is only the Mana Moana group/s themselves who can confirm their 'rights and interests' so it is critical that you provide them with good information about the initiative and potential implications for them and their rohe moana. Note: This only refers to the rights and interests of Mana Moana groups – not there may well be other rights and interests groups to consider.
Step 4: E Toru Ngā Mea – consider what your anticipated level of interest, capacity and capability for involvement means for each of the following aspects or elements of kaitiakitanga: Rangatiratanga: • Who makes decisions? • How many people need to be involved? • At what level of governance and/or management? Mātauranga: • Do you already have sufficient mātauranga, or are there gaps? • Who are the knowledge holders? • Who else needs to be involved? Tikanga: • How should this kaupapa operate? • Who has the necessary tikanga expertise? • How should you and/or others be involved?	**Step 4: E Toru Ngā Mea** – if you do not already have a good relationship with Mana Moana, make sure you consider each of the following aspects or elements of kaitiakitanga before engaging or preparing a proposal: Rangatiratanga: • Who makes decisions? • How many people need to be involved? • At what level of governance and/or management? Mātauranga: • Are you aware of any relevant mātauranga (through other projects or avenues) or who the knowledge holders are? • What is your group or agency's position and view on how mātauranga will be recognised and provided for in the marine governance and management initiative? • Is there an aspiration for co-learning and co-creation of new knowledge? Tikanga: • Are you familiar with the local tikanga and kawa? • Do you or someone in your group or organisation have cultural awareness and competency sufficient to engage Mana Moana appropriately? • How should you and/or others be involved? • Has resourcing been set aside for this purpose (e.g. to support the involvement of kaumatua/kuia, marae etc.)?
Step 5: What does it mean for you? Once you understand the kaitiakitanga principles as they apply to the context you are considering, you will be able to articulate what kaitiakitanga means for you, what things need to be addressed, planned, prioritised, financed or resourced, actioned etc.	

Step 6: Embarking on a collaborative marine governance and management approach	Step 5: Embarking on a collaborative marine governance and management approach
This step is conditional on whether you want or need to engage with anybody else. If you do need to engage with a government agency, industry organisation, community group or other iwi, hapū or whānau etc., then we suggest trying the other complimentary tools: • Mahi Tūhonohono - which supports relationship building. • Te Tiriti Relationship Enhancer - which supports quality assurance.	Once you have developed an understanding in relation to what would be required to enable kaitiakitanga within your marine governance and management context, you may wish to try the other complimentary tools to support any engagement with Mana Moana: • Mahi Tūhonohono - which supports relationship building. • Te Tiriti Relationship Enhancer - which supports quality assurance.

2: Mahi Tūhonohono

Guidance for developing relationships that enable kaitiakitanga

Mahi Tūhonohono provides a simple framework for working together in respectful, reciprocal, and mutually beneficial ways. It extends on the consideration of *E Toru Ngā Mea* by offering a Te Tiriti o Waitangi based (Tiriti-based) approach to provide for kaitiakitanga activation.

"In Ngāti Kahungunu, the phrase we use is mahi tūhono, and so treaties are seen as work that brings people together" – the late Moana Jackson (Ngāti Kahungunu)

Te Tiriti o Waitangi (Te Tiriti) was not the first example of the use of 'treaty' in Aotearoa. Prior to European arrival, treaties (or *mahi tūhono*) provided important mechanisms for supporting relationships between iwi and hapū, who were and often still are, fiercely independent entities. Treaties were used for a variety of reasons, including making trading agreements, peace-making after conflict, and in border regulation.

Te Tiriti (signed in 1840 between Crown representatives and Māori rangatira or chiefs), is widely recognised as New Zealand's founding document. It is also recognised by leading academics, experts and commentators as providing a framework for bringing people together. Some have offered ideas and recommendations for constitutional transformation based on Te Tiriti (such as that envisioned by Matike Mai Aotearoa). Such changes would create greater equity and provision for applying kaitiakitanga. In lieu of such change, *Mahi Tūhonohono* provides guidance to support working together to effectively enable kaitiakitanga using a Tiriti-based analysis.

There are many useful sources of guidance and resources to support Tiriti-based approaches, relationships and operations (such as The Network Waitangi Ōtautahi[8]) and are worth exploration to inform assessment against Te Tiriti itself. Te Kete Kaitiakitanga and *Mahi Tūhonohono* can be used alongside such assessment or independently to enable pragmatic recognition and provision for kaitiakitanga in alignment with Te Tiriti rights, interests, and obligations.

Applying Mahi Tūhonohono – a three step process

1. Identify

We invite users to reimagine and identify the marine governance and management outcomes you want to achieve. Whether you are a kaitiaki, community group, rangatahi, Crown agency official, governor, practitioner, planner, business person, or researcher, consider your specific context and what marine governance or management aspiration you have whether it be at the coast, for the marae, a tourism or commercial venture, resource management need, for policy and planning, or something else.

[8] The Network Waitangi Ōtautahi website provides information and resources to support greater understanding and awareness of Te Tiriti o Waitangi, and guidance on providing for a Treaty-based multicultural future (https://nwo.org.nz)

2. Analyse

Using *E Toru Ngā Mea* where Rangatiratanga + Mātauranga + Tikanga = Kaitiakitanga, consider:

What will it take to whakamana or empower your whānau, community or organisation to achieve those outcomes?

E Toru Ngā Mea focused on an internal inquiry to assist your understanding of **what** kaitiakitanga is in terms of the three key enabling ingredients (Rangatiratanga, Mātauranga and Tikanga). It also aimed to support you to begin your own research or capacity and capability building to meet those requirements. The 'rights and interests' model offered an initial indicator for you to consider the potential extent of Mana Moana interests in marine governance and management.

Mahi Tūhonohono begins to put that internal inquiry to further practice. Rather than a simple fact-finding mission, it encourages you to begin a deeper assessment into **how** kaitiakitanga will be enabled in a specific marine governance and management context. The following checklists provide guidance to support this inquiry:

Guidance for tāngata whenua	*Guidance for agencies, organisations, community groups*
Consider whether you require internal processes to determine what the three principles of Rangatiratanga, Mātauranga, and Tikanga mean for you and your context. Perhaps you need to explore potential relationships with other parts of the system (e.g. with your community, government agencies, commercial ventures etc. to achieve your desired outcomes). Here are some prompts: • Who needs to be involved in early discussions, scoping and relationship building? • Why do they need to be involved and to what extent? • How will you engage with them and what resources will it require? • Is there funding avaialble to support such engagement from within your hapū or iwi, or externally? • What are the advantages and disadvantages to bringing your own resources to this engagement? • What knowledge informs this kaupapa? • What other knowledge and/or data is required, or would assist the outcomes that you and/or the external party want to achieve? • What are your/their timeframes?	Consider the cultural competence and awareness of your group or organisation based on the 3 principles of Rangatiratanga, Mātauranga and Tikanga to support development of Tiriti-based marine governance and management relationships. Here are some questions to help: • What do you already know? • What relationships currently exist? • How strong / positive are they? • Are any of the formal arrangements (e.g. Mana Whakahono a Rohe or Treaty settlement arrangements) in place? • Are you familiar with relevant Treaty settlement and Takutai Moana claims and documentation (such as iwi planning documents on relevant topics)? • Do you know how many Mana Moana entities you need to engage and if not do you know where to find out? • How does their Rangatiratanga, Mātauranga and Tikanga fit in this context at this point in time? • Does your agency or group hold any of their mātauranga, and have any familiarity with their tikanga already? • Do you know the right person to contact and their preferred contact method? (If not, check tribal

• How much capacity and capability exists and do you need to find more?	websites and/or consult regional and unitary councils and/or Crown agencies for advice) • Are you clear about what mandate, agency, data and knowledge you or your organisation has in relation to the outcomes you want to achieve? • If there are gaps, how will you proceed?

3. Share

Mahi Tūhonoho is an exercise that enables you to analyse, assess and prepare yourselves before engaging – a means of undertaking due diligence before embarking in good faith.

If and when both or all parties are eager to engage, it can be useful to undertake the analysis and assessment together. One option might be that you do an independent assessment first, share your results, then work together to address differences and find synergies and points of affinity to progress with from there. The guidance could be used throughout any marine governance and management initiative, to consider appropriateness in planning and scoping stages and to evaluate how well activities or approaches are enabling kaitiakitanga and aligning with Te Tiriti obligations.

Users could develop a 'baseline' of how well marine governance and management aligns with *E Toru Ngā Mea* and maintain a record of that measurement in a shared system (e.g. online platform). The evaluation could be run regularly over the duration of the initiative to support the strengthening or maintenance of already strong relationships for effective marine governance and management tailored for Aotearoa. A more in-depth critical analysis is provided by the following Te Tiriti Relationhip Enhancer tool.

One tool utilised by our research to support collaborative, action-planning, was *Future Search.* We were involved in a 3-day intensive Future Search workshop co-facilitated by Ngāti Paoa ki Waiheke and the Waiheke Marine Project early in their marine governance and management partnership. We also held a 1-day Future Search workshop with 40 representatives from government agencies, and you can find out more (including to gain an understanding of the *Future Search* methodology) by visiting:

https://www.sustainableseaschallenge.co.nz/tools-and-resources/kāwanatanga-future-search-workshop-summary-report/

The effort, energy, relationship building, outputs, and outcomes of that 3-day process were instrumental to the ongoing success of the partnership and momentum of regenerating Waiheke's marine ecosystems; including the co-development of an 'Action Tracker' as part of our research.

3: Te Tiriti Relationship Enhancer

Assessing system design to enhance the enablement of kaitiakitanga

Te Tiriti Relationship Enhancer is a tool that builds on *Mahi Tūhonohono* and *E Toru Ngā Mea*. The process is more in-depth and evaluative, shifting focus away from relationship building and strengthening, towards elements of transparency and accountability, and more aligned with an audit. As an assessment tool it might also be useful to underpin corporate disclosure for example, and as encouraged by the Sustainable Seas Blue Economy Principles.

The tool assists users in evaluating how well marine governance and management initiatives are measuring up to the rights, needs, and aspirations of Mana Moana. It can help to achieve equity and indigenous and environmental justice by ensuring that Te Tiriti partners and their respective worldviews, values, systems, and processes are equally valued and given space within the marine governance and management system. The importance of this was highlighted in the initial systematic review conducted for this research (Parsons et al., 2021). Through a critical analysis of texts (documents and language used in any initiative), users can identify where approaches are going well and where there are gaps or areas that need greater attention.

Te Tiriti Relationship Enhancer recognises that although Te Tiriti o Waitangi was signed almost two centuries ago, its provisions and opportunities have never been realised. This has created an environment that does not provide for kaitiakitanga in that Rangatiratanga, Mātauranga and Tikanga have been actively inhibited. *Te Tiriti Relationship Enhancer* uses texts to reassess and rebalance the dynamics of authority and practice, and support a marine governance and management approach that operates in aroha, and is mana-enhancing.

Texts are sensitive barometers of social process, momentum, and diversity. A critical analysis of texts can be revealing in terms of highlighting ideological language and the social representations that inform them (Chouliaraki & Fairclough 1999). As with the *Mahi Tūhonohono*, this tool draws from an already established methodology for the critical analysis of texts and their associated discourses through a Tiriti lens[9].

The tool can be applied to marine governance and management plans, policies, strategies, funding bids, and any related documents that involve or are relevant to Mana Moana. Alignment with Te Tiriti and the principles of kaitiakitanga can be measured, and an assessment made of whether the text and the context it relates to, upholds and honours the rights, interests, and values of all involved. Like *E Toru Ngā Mea* and *Mahi Tūhonohono*, this tool can be used for any scale, context, and stage of initiative. Put simply, it is an accessible Tiriti-based tool to maintain or encourage transparency and accountability in and across marine governance and management.

[9] The tool is adapted from an earlier Aotearoa-specific tool, the Critical Tiriti Analysis (CTA) developed by Came et al. 2020 which was initially developed for the health and medical sector.

Applying the tool

The tool involves a review of texts against the principles of kaitiakitanga. The review process has six defined phases[10]:

STEP	PHASE	PROCESS
1	Choice	Choose a text and a question or issue you want to constructively critique
2	Orientation	"Word Search" key terms identified through the Mahi Tūhonohono tool that Mana Moana positively associated with marine governance and management (i.e. terms related to enabling and giving effect to the principles of rangatiratanga, mātauranga, and tikanga). For example Tiriti, Treaty, rangatira/rangatiratanga, kaitiaki/kaitiakitanga, mana whenua, mana moana, tikanga, mātauranga, Māori, mauri. Record the resultant number of terms. That number provides a simple first measure of the extent of Tiriti and E Toru Ngā Mea compliance.
3	Close Reading	A second, close reading (critique) of the texts against the three principles (rangatiratanga, mātauranga, and tikanga). You may also want to include a close reading against elements of Te Tiriti: preamble, Articles I, II, III, and Article IV an oral article.
4	Determination	Apply a series of indicators (for example, policy development, performance, and evaluation) that could be ranked on a Likert-type scale for each of the three (or five if using Te Tiriti) points of analysis outlined above.
5	Strengthening Practice	Summarise key recommendations that emerge from steps 1 – 3 for how to strengthen practice within the given context.
6	Māori Final Word	Make conclusions relevant to your specific context in relation to enhancing the mana and rangatiratanga of Mana Moana to better enable kaitiakitanga and a Tiriti-based marine governance and management system. This section is reserved for Mana Moana (or a person from their delegation).

A critical evaluation using this tool can provide a deeper understanding of language and patterns to identify what has led, or is in the process of leading, to the development and operation of an Aotearoa-based marine governance and management approach, including approaches based on EBM and kaitiakitanga. At the same time, it supports the identification of inconsistencies and ambivalence that might offer possibilities for approaches to shift or be re-designed to take a more holistic, integrated, and just, Tiriti-based or aligned pathway.

Our research project tested this methodology on the Sustainable Seas National Science Challenge revealing insights about its strengths and weaknesses with regard to the way it has provided for kaitiakitanga and the extent to which it has applied a Tiriti-based approach.

[10] Adapted from Came et al. (2020)

He Mihi

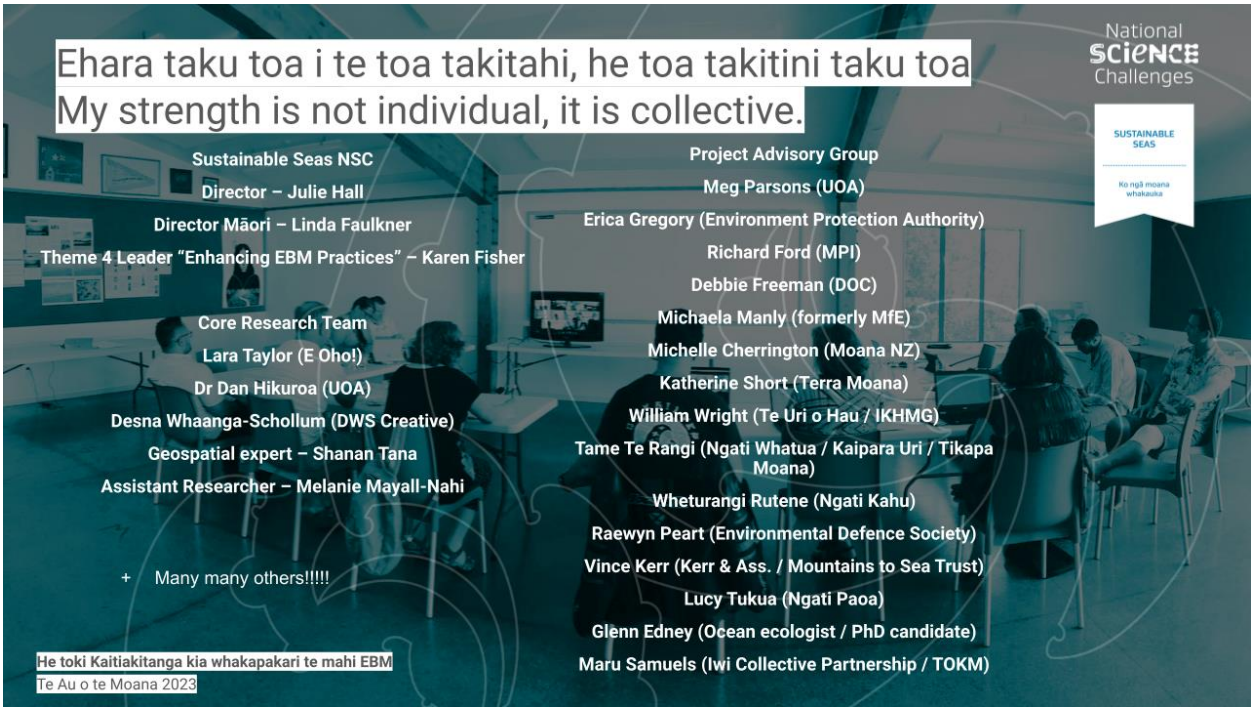
Ehara taku toa i te toa takitahi, he toa takitini taku toa | My strength is not individual, it is collective.

Postcolonial relationships are non-homogenous, differing across time and place in Aotearoa and throughout the postcolonial world. It is important to hear and capture the many voices from both those in power, and at the margins and those spaces in between. We are extremely grateful to the substantial number of research partners and participants that were engaged in the research project that informed *Te Kete Kaitiakitanga*.

Our approach resulted in both an intentional collective advisory group and a more spontaneous collective of interested participants who chose to engage in our research or host us as presenters, panelists, or participants at relevant events over the course of our research.

Method	Type	Rangatiratanga Sphere	Kāwanatanga Sphere	Relational/Oritetanga Sphere
1	Project Advisory Group	Michelle Cherrington (Moana NZ); William Wright (Kaipara Uri); Tame Te Rangi (Ngāti Whātua/Kaipara Uri/Tikapa Moana); Wheturangi Rutene (Ngāti Kahu); Lucy Tukua (Ngāti Paoa); Maru Samuels (Iwi Collective Partnership).	Erica Gregory (Environmental Protection Agency); Richard Ford (Ministry Primary Industries & NZ Fisheries); Debbie Freeman (Department of Conservation); Michaela Manly (formerly Ministry for the Environment).	Dr Meg Parsons (University of Auckland); Katherine Short (Terra Moana); Raewyn Peart (Environmental Defence Society); Vince Kerr (Kerr & Ass./Mountains to Sea Trust); Glenn Edney (Ocean ecologist/PhD candidate).
2	Sphere of Influence Partnerships	Moana New Zealand, the largest Māori-owned seafood company, which provided a corporate context within the rangatiratanga sphere.	Cross-government agencies collaborative working group, which included key representatives from EPA, MPI, DOC, and MFE (see cell above) and research that involved wider colleagues from each agency.	Waiheke Marine Project and Ngāti Paoa ki Waiheke, a flax-roots initiative focused on the protection and regeneration of Waiheke Island's marine environment through the use of action-based kaitiakitanga. They are developing 'an Ahu Moana approach in an urban context'.
3	Individuals and groups from across the whole system	A multitude of people, agencies, organisations, conferences, hui, wānanga across SOI – both national and international audiences and in-person and online.		

Our small team of three was honoured to have hundreds of kōrero with actors from across the whole system. Those many narratives - sharing experiences, learnings, and insights all contributed to the co-development of the three tools. We also acknowledge and thank the Sustainable Seas National Science Challenge and Ministry of Business, Innovation, and Employment for funding and supporting our endeavours.



In closing, we reflect on a whakatauākī by Te Puea Herangi:

Mahia te mahi, hei painga mo te iwi,

and expand it to:

Mahia te mahi, hei painga mo te moana.

Te Kete Kaitiakitanga

Supporting reference material

Kaitiakitanga

Kaitiakitanga is an ethic of care, embodied by (but not limited to) humans aka Kaitiaki that whakapapa to a place and all of its natural entities, and have inherited obligations to care for those respectively.

Te Ao Māori (the Māori world, ways of thinking, or worldviews) is founded on relationality, reciprocity, and respect between all things (living and non-living) and this is understood through whakapapa (genealogical connections) and whanaungatanga (kinship). Though there are shared principles and values across tangata whenua from different rohe (tribal regions), there are multiple Te Ao Māori views because each iwi, hapū and whānau has their own understanding based on their relationships with the unique environments within their different rohe. Their respective identities, obligations and responsibilities regarding MGM are based on those ways of knowing (mātauranga) and being (tikanga) in relationship with Te Ao Tūroa (natural environment), as it pertains to their rohe. Te Ao Tūroa cannot be isolated from the people that inhabit it.

In Te Ao Māori, people do not own the land, sea, or other taonga (gifts – often considered 'resources' in western vernacular). Rather, they are the teina (younger sibling) connected through whakapapa to those taonga which are tuakana (older siblings). According to Dr Henare Tuwhangai "Māori people did not just own whenua or Te Ao Turoa, but that they, the people, were also the possession and the land and Te Ao Turoa were the possessors" (in Henare 1988:28). Mana whenua mana moana describes iwi/hapū/whānau who are imbued with mana and rangatiratanga over specific whenua (land) and moana (sea), which is based on strength of whakapapa ties and length of occupation. Jackson (2017:110) found that "Mana whenua and mana moana status is implicit and mandatory for the exercise of kaitiakitanga".

Kaitiakitanga is the manifestation of the Māori 'ethic of care', which can include environmental contexts and/or humans, but also extends beyond humans. The inclusion of kaitiakitanga within contemporary environmental legislation and policies often associates it exclusively with humans, which has likely influenced the more modern construction and normalisation of kaitiaki as people (though kaitiaki can take many other forms within the natural environment). Mana whenua mana moana can embody the role of 'kaitiaki' in which they practice kaitiakitanga. A dialectical relationship exists between kaitiakitanga and rangatiratanga. Kaitiakitanga is both an expression and affirmation of rangatiratanga; and rangatiratanga is the authority for kaitiakitanga to be exercised (Kawharu, 2000:353). Harmsworth (2005) adds that kaitiakitanga "is the practice of spiritual and physical guardianship based on tikanga" (p. 129) and asserts that,

kaitiakitanga is an 'active' rather than 'passive' guardianship or custodianship. It conferred obligations rather than a right to make decisions, and placed obligations to make wise decisions about resource management, and to sustain the wellbeing of iwi, hapū, and whānau. All had the collective responsibility to ensure that resources were managed wisely…Kaitiakitanga is inextricably linked to tino rangatiratanga.

Kaitiakitanga is an active form of management of human relationships with the taiao, rather than the Western ethic of 'conservation' which separates people from the environment and makes them passive carers or conservers and preservers 'of nature' McAllister et al. (2023). Whereas customarily, Kaitiakitanga includes active harvesting and use, based on respect and reciprocity including harvesting of taonga species. One example is the traditional harvesting of a native seabird called tītī or 'muttonbirds' (Sooty Shearwater chicks) by Rakiura (Ngāi Tahu) Māori, a practice that has occurred for centuries in accordance with mātauranga and tikanga. Since 2002, mana whenua and Otago University researchers have implemented a bicultural research approach to study the harvest, with Māori research aspirations being at the centre and across all aspects of the programme but both Indigenous knowledge and ecological science contributing valid data (Lyver and Moller, 2012). The aim is not to integrate the two knowledge systems, which is considered "unlikely because of the spiritual and holistic aspects that partially define traditional knowledge. However, parallel use of the two knowledge systems may improve the understanding and decision-making for conservation and natural resource use" (Lyver, 2002).

Kaitiakitanga is an intersectionality of multiple discourses, in particular rangatiratanga, tikanga, and mātauranga, which together give effect to kaitiakitanga. In her seminal work on kaitiakitanga, Māori researcher Anne-Marie Jackson (2017) articulates and discusses the many "complex" discourses associated with kaitiakitanga. Jackson (2017: iii) characterises mātauranga as "a complex knowledge system comprising intergenerational beliefs, values and practices, that comprises what is known and how it is known, that can be utilised to sustainably manage the marine environment". Jackson's research found (2017:132) that mātauranga is embodied by people/kaitiaki through oral traditions including: tikanga (customs and protocols), karakia (incantations), whakapapa (genealogies), mōteatea (chants), pūrākau (stories and narratives), maramataka (lunar calendar and heavenly bodies), kupu (relevant words), waka voyaging traditions, and kaitiakitanga (guardianship), pēpeha (tribal sayings) and whakataukī (proverbs).

Jackson (2017:40-41) concludes in her report that "tikanga is composed of a complex array of beliefs, values, principles and precedents, which can be defined in a number of different ways". The most common interpretation is as custom or Te Ao Māori way of doing things which governs interactions between ourselves, ecosystems (including people), and the celestial world. However, Hirini Mead (another profound Māori scholar) (2003) posits that tikanga may also refer to a role, plan, or method which has implications for the practice of kaitiakitanga. Mead (2003) and Jackson (2017) relate tikanga to mātauranga which provides the complex and vast knowledge base, evolving with time, conveying the view that one must understand both, together, to understand either at all. Mead (2003:7) explains that "mātauranga Māori might be carried in the minds, tikanga Māori puts that knowledge into practice and adds the aspects of correctness and ritual support". It is this respect and reverence that elevates Te Ao Māori (and other indigenous knowledges) above modernist ontologies and offers more than procedural, technocratic "resource management".

Kaitiakitanga is embedded within an interwoven set of values, morals, ethics and principles that emerge through the dynamic and always evolving creation process in which humanity and all of the natural world are constantly becoming. In Māori culture this is expressed as "I te kore, ki te pō, ki te ao mārama" which is commonly translated to "out of the nothingness, into the night, into the world of light".

> *…the cosmos began with a surge of primal power. From this, thought emerged, followed by memory, the mind-heart, knowledge, darkness and the kore (the nothingness, potential forms of existence). Tapu, or cosmic power, was the source of all creation. It brought complementary forms of life together, generating new beings.*

Tapu (cosmic power), mana (privilege, authority, reciprocal obligations that come with it), wairua (spirit), hau (breath), and mauri (an essential life force) emerge through the cosmos, becoming inherited by entities in Te Ao Marama. Everything has sacred potential and must be respected in that sense; the greater the potential or realised potential, the greater the tapu and subsequent levels of respect and reverence. Everything has mauri to be maintained and protected. Mauri is the spark of life, vitality, and energy. The regenerative life-essence that connects people and spirit (wairua) to each other and all other entities within Te Ao Tūroa (the natural world). Mauri flows, and where it is strong, ecosystems and communities flourish. However, when mauri is degraded and weak, so are the respective ecosystems and communities, requiring kaitiaki to take restorative action to rebalance the system (Whaanga-Schollum 2019).

In the practice of kaitiakitanga, environmental resources are understood as taonga (gifts) inherited through whakapapa, along with the obligation to care for those taonga. Sir James Henare (2001) described this as:

> *The Māori word 'whenua' – land, is the term used for both the land and placenta or afterbirth, therefore, the land for Māori people has the same deep significance as the placenta, which surrounds the embryo. Giving it warmth and security, a mauri, a life force that relates to and interacts with Mother Earth's forces.*

Humanity is therefore fundamentally connected through whakapapa to Papatūānuku, and the ongoing creation process occurs through networks of kinship and connection, transmitting whakapapa and transgenerational mātauranga and tikanga. There is a regenerative relationality or reciprocal exchange that exists between the hearts and minds of individual people, and between human beings and matter (Salmond et al. 2019). This philosophy is shared with indigenous nations across the Pacific, and beyond (for example refer Simpson 2017). Interconnections between humans, non-humans, and more-than-humans manifest in tune or rhythm with one another. The vitality of humanity is therefore reflected by that of the natural environment. Psychological and social dis-ease are attributed to the errors of the past – degradation and loss of land and taonga. In sum, ill treatment of Papatūānuku our Earth Mother produces unwell communities and vice versa (Henare 2001:205).

The complexity of ethics regarding Te Ao Māori has been characterised as 'a spiral of traditional ethics, which simultaneously presents Māori worldview and acts as a check on that worldview' (Henare et al. 2021:64-65; Henare, 2003):

- Tikanga te ao mārama: ethic of wholeness, evolving, cosmos
- Tikanga te ao hurihuri: ethic of change and tradition
- Tikanga tapu: ethic of existence, being with potentiality, power, the sacred
- Tikanga mauri: ethic of life essences, vitalism, reverence for life
- Tikanga mana: ethic of power, authority, and common good, actualization of tapu
- Tikanga hau: ethic of spiritual power of obligatory reciprocity in relationships with nature, life force, breath of life
- Tikanga wairua: ethic of the spirit and spirituality
- Tikanga tika: ethic of the distinctive nature of things, of the right way, of the quest for justice
- Tikanga whanau: ethic of family, tangata - the human person
- Tikanga whanaungatanga: ethic of belonging, reverence for the human person
- Tikanga tiakitanga: ethic of guardianship, of creation, land, seas, forests, environment

- Tikanga houhou rongo: ethic of peace and reconciliation, restoration
- Tikanga kotahitanga: ethic of solidarity with people and the natural world and common good
- Tikanga manaakitanga-atawhai: ethic of love and honour, solidarity, reciprocity

This fundamental set of virtues and ethics has governed the exercise of rangatiratanga since the nineteenth century, remaining functional within Māori society today. The list above (part of a broader framework by Henare et al. 2021) was offered by Henare as a set of virtues and ethics to inform Māori relationships with Māori, and relationships between Tangata Whenua and Tangata Tiriti. It is therefore useful for guiding relationships within a Tiriti-based marine governance and management context.

[This research focused on people as kaitiaki but in Te Ao Māori other beings (both human and more than human) can be kaitiaki too.]

Ecosystem-Based Management

The Sustainable Seas National Science Challenge (one of 11 nation-wide, and government funded science "challenges") embarked on an ambitious, mission-led response to address complex, interdisciplinary issues including marine governance and management, and to spend science investment more strategically within Aotearoa. The Challenge was a collaboration of researchers, scientists, practitioners, and others that work across boundaries to address the multiple and overlapping socio-ecological, political, cultural and economic issues now associated with this focus area. It brought together 220+ researchers from 36 organisations across Aotearoa New Zealand and had numerous advisory groups. Māori specialists and tribal representatives as well as government agency officials were involved across the Challenge, with input within the governance and leadership structure including the kāhui Māori (Māori advisory group) and stakeholder panel (which included government organisations, communities, industry, researchers, resource managers and NGOs), and within specific themes and projects. The government's Vision Mātauranga policy ensured that Māori knowledge was included, both in its own theme and across all other themes, and that there would be outputs and outcomes relevant for Māori (Hewitt et al. 2018).

During the establishment phase the Challenge determined an Ecosystem-Based Management (EBM) agenda as the research focus (Hewitt et al. 2018:10). EBM was chosen for its capacity to move away from sector-specific, siloed management toward more holistic, integrated, decentralised and collaborative management that values and prioritises interrelated socio-ecological factors as well as economic ones. To characterise EBM and tailor it to Aotearoa, the Challenge developed a working definition and seven key principles (refer Figure below).

Figure 1: The Sustainable Seas National Science Challenge's conceptualisation of EBM for Aotearoa.

These principles, the definition, objective, and mission were developed with input from stakeholders and Māori partners. The Challenge referred to the EBM concept as a work in progress which was anticipated to evolve (Hewitt et al. 2018).

Definition: A holistic and inclusive way to manage marine environments and the competing uses for, demands on, and ways that New Zealanders value them.

Challenge Objective: Enhanced utilisation of our marine resources within environmental and biological constraints.

Challenge Mission: Transformation of Aotearoa New Zealand's ability to enhance our marine economy, and to improve decision-making and the health of our seas through ecosystem-based management.

In a settler colonial context such as Aotearoa New Zealand, there are significant tensions that arise as different worldviews come into contact. For instance, both the Challenge objective and mission emphasise human use and economic productivity, which reflects the political economic context within which science funding in Aotearoa New Zealand is determined. This can be seen as the continued privileging of western 'modernist' onto-political perspectives and governance agendas that have emerged through colonial expansion. 'Modernity' is an ensemble of socio-cultural norms, attitudes and practices that follow enlightenment thinking and a tendency to separate nature from culture. According to Fisher

et al. (2022) "modernist governance arrangements, therefore, tend to simplify the natural world and the myriad socio-natural relationships that exist in relation to places, to conceive of participation, rights, and property in constrained terms and rely on prescriptive or technocractic solutions to address environmental problems (DePuy et al. 2021; Makey et al. 2021). In contrast, Māori-led and Māori-centric research undertaken in the Challenge emphasises values beyond economic value, and an understanding of the moana that emphasises relationality and connection between tāngata whenua and te taiao (the environment) across past, present, and future generations. Moreover, research that emphasises the agency and mana of tāngata whenua in exercising authority, the reimagining of economic futures and an indigenised blue economy, and which contemplates new models of marine management that better reflect Te Tiriti rights and interests represent important developments to challenge 'modernist' assumptions underpinning governance and management.

Notwithstanding the 'baggage' that accompanies EBM as a western concept (Fisher et al., 2022), there is evidence of EBM enabling a shift to more holistic and inclusive management practices in Aotearoa that are better able to accommodate Māori rights and interests and expression of Te Ao Māori. However, the relationship between EBM and kaitiakitanga requires careful navigation to ensure that rangatiratanga, mātauranga and tikanga of mana whenua is foregrounded and respected.

Some Māori scholars suggest it is possible to use "ecosystem" thinking in relation to Māori under certain conditions. For example Garth Harmsworth and Shaun Awatere (2013:246) argue that:

Respecting and valuing the Māori world view and Māori concepts is an essential first step to understanding the iwi/hapū perspective of ecosystems. The term ecosystem needs to be understood within Māori contexts and frameworks (e.g. Douglas 1984; Awatere et al. 2011, 2012) to be meaningful to Māori and allow them to participate more fully in dialogue, protection and sustainability of ecosystems through inclusive management planning and policy setting.

Further Reading:

Enabling Kaitiakitanga and EBM – Information about this Sustainable Seas National Science Challenge project: https://www.sustainableseaschallenge.co.nz/our-research/enabling-kaitiakitanga-and-ebm/

Matike Mai Aotearoa: The Independent Working Group on Constitutional Transformation (refer to their report here published in 2016

The Network Waitangi Ōtautahi website provides information and resources to support greater understanding and awareness of Te Tiriti o Waitangi, and guidance on providing for a Treaty-based multicultural future (https://nwo.org.nz)

Future Search information: https://www.sustainableseaschallenge.co.nz/tools-and-resources/kāwanatanga-future-search-workshop-summary-report/

Appendix B Engaging with Te Ātiawa o Te Waka-a-Māui Trust

Engaging with Te Ātiawa o Te Waka-a-Māui Trust

An insight into potential considerations Researchers and Project Managers to consider when starting research projects that require Te Ātiawa o Te Waka-a-Māui Trust involvement.

Te Ātiawa o Te Waka-a-Māui Trust
Waikawa, Picton
PO Box 340, Picton 7250
Ph : (03) 573 5170 / 0800 284 292
Email : taiao@teatiawatrust.co.nz
Website : www.teatiawatrust.co.nz

Shellfish Restoration Project

Toitū te marae a Tāne, Toitū te marae a tangaroa, Toitū te iwi

If the realms of Tāne and Tangaroa are sustained, then so too will iwi

22 March 2024

Report Writers: Kristie Paki Paki – Pou Taiao and Kiara Duke-Love - Kaitiaki mō te Taiao , Te Ātiawa o Te Waka-a-Māui Trust.

This report has been prepared as part of the NIWA report "Considerations for rehabilitation of shellfish and shellfish habitat in the Marlborough Sounds", prepared for the Sustainable Seas National the Sustainable Seas National Science Challenge | Ministry of Business, Innovation and Employment.

Confidentiality - Intellectual Property:

1. Kupu Whakataki - Introduction

Te Ātiawa o Te Waka-a-Māui (Te Ātiawa) connects with the three hapū, Te Kāhui Tu, Te Kāhui Rangi and Te Kāhui Tawake. These hapū originated from the ancestor Rua Taranaki, the first man to climb Maunga Taranaki. Some of the earliest tangata whenua to have occupied Tōtaranui (Queen Charlotte Sound) and surrounds came from these three hapū.

In the late 1820s, sections of Te Ātiawa migrated south and settled in Te Tau Ihu o Te Waka-a-Māui (the Northern South Island) after a series of victorious battles against the resident Kurahaupō peoples. Through this process, Te Ātiawa established their mana and rangatiratanga and acquired customary rights over whenua and moana at Tōtaranui (Queen Charlotte Sounds), Kura te Au (Tory Channel), Waitohi (Picton), Anamahanga (Port Gore), Te Tai o Aorere (Tasman Bay), Whakatū (Nelson), Motueka, Mōhua (Golden Bay) and Te Tai Tapu.

Te Ātiawa, by geographical choice and necessity, are coastal dwellers that have placed high cultural and spiritual values upon the foreshore, seabed, coastal and maritime waterways. Both the lands and waters are in turn connected to the people as the mana whenua, mana moana, mana tangata in this rohe. Te Ātiawa hapū relationships with te takutai moana are captured in memories, ingrained in hearts and passed on in practice, stories and waiata to children and grandchildren who will one day be the kaitiaki of the coastal domain. Te Ātiawa view the resources of the sea as gifts from Tangaroa and have developed complex management systems (tikanga) to prevent over-exploitation.

The waters of the sea and rivers are as much roads and gardens as the roads and gardens on land. For generations, Te Ātiawa have fished these waters with great care and many are still fishing these waters both customary and commercially. As mana whenua mana moana of the area of Tōtaranui, Te Ātiawa have consistently exercised kaitiakitanga over the area and surrounding sounds and islands since our arrival.

The responsibility of kaitiakitanga is inherited through whakapapa and is a duty that ensures the sustainable management of environmental resources and associated taonga. Te Ātiawa hold both customary rights and whakapapa obligations to maintain the mauri and integrity of matters of importance through the exercise of rangatiratanga.

The natural environment of Tōtaranui consists of bays with varying depths, headland reefs, cobble fringes, sub-tidal slopes, and deep mud flats. The area is renowned for kina, scallops, crayfish, and shell mussels. Kaimoana resources hold immense cultural and sustenance value for Te Ātiawa.[1]

[1] Deed of Settlement – Te Ātiawa o te Waka-a-Māui, and Cultural Effects Assessment – Ecologically Significant Marine Sites, 2024.

2. Process and Implementation

Whakawhanaungatanga – Establishing connections and building a relationship

Prior to applying for project funding and throughout development, it is important that project managers establish a relationship. Depending on the kaupapa – this may need to occur with the Te Ātiawa o Te Waka-a-Māui trust Board of Trustees, or with whānau or with the Trust's kaimahi – it really depends on the Kaupapa. Initial stages of establishing a relationship could involve giving a presentation to gauge initial support for the project, or simply setting up a relationship building hui. Like any important relationship, it may take months or even years to build trust and support for your kaupapa. We generally do not support the process whereby project managers apply for funds, where the application outlines our involvement, without prior engagement.

Below is a non-comprehensive list of pātai (questions) we recommend researchers to consider before approaching Te Ātiawa with a research proposal.

- Have I (the researcher) done my due diligence to understand how the project I am proposing will elevate Wai 262, Te Tiriti o Waitangi and will ensure mātauranga Māori are protected and valued equally?
- Have I clearly identified in my proposal how I perceive the project will provide long-term social, physical, economic and spiritual benefits to the whānau of Te Ātiawa o Te Waka-a-Māui?
- Are my deadlines realistically achievable and flexible to the competing priorities of Te Ātiawa o Te Waka-a-Māui trust?
- Have I included a buffer of incidental time and resources to allow Te Ātiawa o Te Waka-a-Māui trust and/or whānau time to consult with others on my proposal?
- Does my proposal ensure Te Ātiawa o Te Waka-a-Māui have leadership over the taonga aspects of the project?
- How will data be protected, stored and shared as part of this project and can I ensure sovereignty of any data which Te Ātiawa o Te Waka-a-Māui Trust or whānau consider sensitive?
- Am I prepared to be questioned and challenged?
- If I am seeking to co-design my proposed project with kaitiaki from Te Ātiawa o Te Waka-a-Māui, and am I resourcing their expertise in a way which ensures equity?
- How will the project develop a reciprocal relationship with kaitiaki which will build capacity and capability?

We may choose not to participate if the project's objectives do not align with our aspirations or priorities.

For further guidance on best practise scientific partnership, we recommend the Rauika Mangai resources found at – https://www.rauikamangai.co.nz/resources-hub/

National/ local issues/ Iwi Dynamics

It is helpful for Project Managers and researchers to have some understanding of wider Māori issues and concepts, either within a geographic area or nationally, and be aware of inter-iwi and intra-iwi politics and relationships.

Resourcing

During project scoping and preparing funding applications, resourcing for our participation must be included in the project budget. The amount of resourcing will be dependent on the scope of participation agreed to in the project development. **Examples of resourcing that we may require are whānau engagement, site visits, research, communications, legal advice, etc.**

Ethics Application

From the outset, and before any research data gathering is undertaken, an ethics application must be developed. This should be a document that sets out the tikanga and professional research protocols to ensure an appropriate process for engaging whānau and for the collection, storage, photo treatment, and use of any mātauranga shared with the research teams or generated by the project. **The ethics application tikanga should be captured in an agreement that includes details on how the wider working relationship will work, as explained below.**

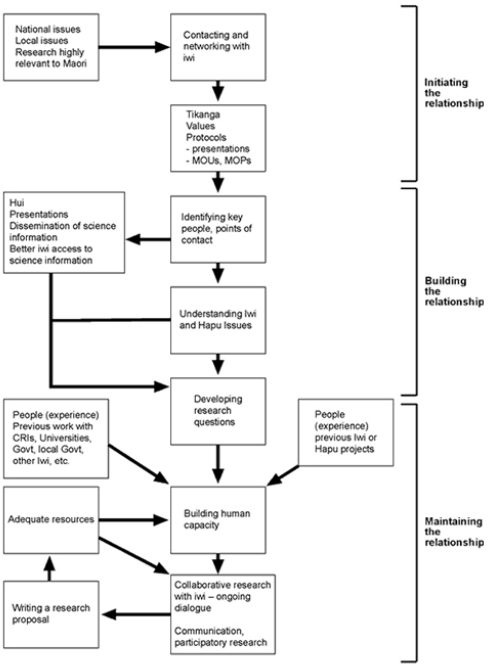
Tikanga

There must be sufficient time to allow for discussion around tikanga (cultural protocols) and kaupapa Māori (Māori-defined) methodologies tailored to Te Ātiawa o te Waka-a-Māui. Collectively, we need to consider how we are going to work together on the project and jointly prepare a 'Terms of Agreement' or 'Memorandum of Understanding' type document to guide our collaborative research. The agreement should consider:

- the kaupapa, which can take the form of a set of guidelines, a guiding philosophy, a terms of reference, outcomes and vision for the proposed project;
- the size and or magnitude of the project;
- the proposed time-frame;
- important protocols, tikanga, and cultural sensitivities that should be followed when developing the research proposal;
- the key issues the proposal will address;
- the people, groups, communities, and stakeholders who are the target end-users or beneficiaries of the research, and the relevance or significance of the research to them;
- the people, groups, and stakeholders to be involved in the actual research (e.g., the collaborators);
- specific research questions the iwi and collaborators want answered;
- specific research questions other groups or stakeholders may want to be answered;
- whether the research questions will in fact, contribute to the outcomes and accurately address and provide answers in line with the issues;
- an effective communication strategy during the writing of the proposal;
- a list of points where approval or review from the Board of Trustees may be required.
- an effective communication strategy and key contacts to maintain collaborative links.[2]

[2] The information is drawn from:

HARMSWORTH, G. 2005. Good Practice guidelines for working with tangata whenua and Maori organisations: Consolidating our learning. Report prepared for Integrated Catchment Mangement Programme, Motueka, funded by FRST.



An example to show the complexities associated with meaningful engagement[3]

3. More specific details to the Shellfish Restoration Project

To prepare for whānau engagement, kaimahi of Te Ātiawa o Te Waka-a-Māui trust would:

- Ask the Project Developer to follow the processes outlined in this document.
- Ask for project communication materials required to coordinate a whānau hui.
- Prepare for and attend the hui, collate whānau feedback, and manage data as per the tikanga agreed to during project development.

Whānau engagement workshops could include the following:

- Developing the project tikanga.
- Mapping bays and sites of significance within Tōtaranui for mahinga kai.
- Organise site visits to be facilitated by and for whānau.
- Discussing and capturing restorative aspirations for Tōtaranui.
- Capturing the ao Māori values, which will provide direction to project mahi.
- Gathering advice on how cultural narrative is weaved through all communications around the project, including naming, karakia, waiata, and rauemi (resources).
- Coordinate sign off from Te Ātiawa o Te Waka-a-Māui Board of Trustees for any reports/products produced.
- Co-developing action plans that whānau can be involved in.