National SCIENCE Challenges

Piloting the use of Systems Mapping in the Sustainable Seas National Science Challenge

Causal Loop Mapping Pilot – a whānau perspective for Te Tai-o-Aorere ki Mohua

June 2024

Report by:

Justin Connolly   **Director, Deliberate**

Kelly May   **Marine Scientist – Te Kūwaha, NIWA**

Kura Stafford   *Former* **Pou Taiao Ngāti Tama ki Te Waipounamu Trust**

Recommended citation:

Connolly, J.D., May, K., Stafford, K. (2024). *Piloting the use of Systems Mapping in the Sustainable Seas National Science Challenge: Causal Loop Mapping Pilot – a whānau perspective for Te Tai-o-Aorere ki Mohua*. (A report for the Sustainable Seas National Science Challenge). Hamilton, New Zealand: Deliberate.

Version

Date	Comments	Authorised by
12 July 2021	Draft report issued for comment	Justin Connolly, Director, Deliberate Kelly May, Marine Scientist, Te Kūwaha, NIWA Kura Stafford, Pou Taiao - Resource Management Manager, Ngāti Tama ki Te Waipounamu Trust
14 January 2022	Revised report issued for comment	Justin Connolly, Director, Deliberate Kelly May, Marine Scientist, Te Kūwaha, NIWA Kura Stafford, Pou Taiao Manager Ngāti Tama ki Te Waipounamu Trust
26 June 2024	Final report issued	Justin Connolly, Director, Deliberate Kelly May, Marine Scientist, Te Kūwaha, NIWA Kura Stafford, *Former* Pou Taiao Manager Ngāti Tama ki Te Waipounamu Trust

Disclaimer

SUSTAINABLE SEAS
i
Piloting the use of Systems Mapping in the Sustainable Seas National Science Challenge
Causal Loop Mapping Pilot – a whānau perspective for Te Tai Aorere ki Mohua

Karakia

Ko Rangi

Ko Papa

Ka puta, ko Rongo

Ko Tānemahuta

Ko Tangaroa

Ko Tūmatauenga

Ko Haumiatiketike

Ko Tāwhirimātea

Tokona te Rangi ki runga

Ko Papatūānuku ki raro

Ka puta te ira tangata

Ki te whai ao, ki te ao mārama

E rongo whakairia ake ki runga

Kia tīna! Tīna!

Haumi e, hui e, tāiki e!

Te Huirangi Waikerepuru

This karakia acknowledges the primordial parents Ranginui and Papatūānuku and the children they begat and their progeny who populated the world. They were the source from which all things in the universe originated including other deities, humans and the various creatures and features of the earth.

Mihimihi

Mai i ngā maunga whakahī i Kahurangi ki Whangamoa e tū karapoti nei. E tū, e tū, e tū.

Heke iho ki ngā wai tukunga kiri a ō tātou mātua tūpuna e rere atu rā ki te takapou whāriki o Tangaroa, te pātaka kai a te iwi, e hora ake nei.

Ki ngā hau angiangi e pupuhi mai nei, hei tohu maharatanga ki te hunga kua nunumi atu i te tirohanga kanohi, haere i te ara tē hoki mai ai.

Koutou te hunga wairua ki koutou. Tātou ngā waihotanga ake o rātou mā, e noho mai nei i te āhuru mōwai o Te Tauihu o Te Waka a Māui. Tēnā anō huihui mai tātou katoa. (Te Ahu Rei Ngāti Tama ki Te Tauihu 2021)

From the sentinels at Kahurangi to Whangamoa that encircle us. Stand in your majestic splendour. Descending to the waterways, the bathing places of our ancestors within the realm of Tangaroa, the storehouse of the people. To the gentle breezes, that are a constant reminder of those who have passed beyond the veil and taken the pathway of no return. You of the spirit world (who are never forgotten) o those of us who remain within the haven of Te Tauihu o Te Waka a Māui. Greetings to all that remain.

Contents

List of figures

List of tables

Acknowledgements

Kia hora te marino ki ngā tāmariki o Tangaroa, kia whakaora te moana, kia manaaki tātou ki Te Ao Mārama. Tihei mauri ora!

He mihi maioha tēnei ki ngā kaitiaki o Te Tai-o-Aorere ki Mohua. Ko tēnei te mihi mahana kia koutou katoa, ko ngā kaumatua rātau ko ngā paeke, ko ngā rangatahi, ko ngā tamariki o te iwi nei.

Glossary

Table 1. Glossary

Kupu Māori	Interpretation/kupu pākeha
Ahi-kā-roa	Continuous occupation
Atua	Spiritual guardian
Awa	River/s
Haukāinga	Home people
Hiwi	Hull
Iwi	Is an extended tribal grouping that consists of hapū or whānau who typically share descent from a common ancestor and associate with a distinct territory
Kai	Food
Kāinga	Village/s
Kaimoana	Seafood
Kawa	Customs/protocols
Kaitiaki	In a contemporary context, Kaitiaki is used to describe people who are charged with the guardianship and care of their rohe by virtue of whakapapa
Kaitiakitanga	The duty and obligation arising from whakapapa to nurture and care for te taiao mauri and physical health and well-being. Kaitiakitanga and mauri are intimately connected
Karakia	Incantation
Kupu	Word
Marae	Whānau, hapū gathering place
Mahinga kai	Food gathering place
Mātaitai	Customary seafood gathering site
Mana Whenua and Mana Moana	Territorial rights and authority to land and sea
Māramatanga	Insight matters
Mātauranga	Mātauranga encapsulates te ao Māori. It is a system of intergenerational knowledge, both spiritual and physical, and understanding of all things living and non-living that adapts and evolves with experiencing place-based relationships from generation to generation. There are various forms of mātauranga, including and not exclusive to mātauranga a-iwi, a-hapū, a-whānau that are shaped according to the relationship between tāngata whenua and various ecosystems. Each whānau, hapū and iwi will have their own narrative experiences, learnings and customary practices. Mātauranga is a dynamic and evolving knowledge system.
Maunga	Mountain/s
Mauri	Essential life force, mana, value inherent in all things both living and non-living. Mauri and kaitiakitanga are intimately connected
Papanoho	Deck of a double hulled canoe
Papakāinga	Settlement/s
Papatūānuku	Earth mother
Ranginui	Sky father
Rāhui	Temporary ritual prohibition/restriction
Rangatiratanga	Chieftainship, authority, self-determination, sovereignty, autonomy
Rohe	Tribal region
Taiao	Natural world

Kupu Māori	Interpretation/kupu pākeha
Tangaroa	Atua of sea and fish
Tāngata whenua	People of the land with authority in a particular rohe
Taniwha	Spiritual guardian
Taonga	Treasure
Tauiwi	Non-Māori
Tiaki	To look after
Tikanga	Cultural protocols and processes
Tipua	Supernatural beings
Te Ao Māori	Māori world
Te reo Māori	Māori language
Tikanga	Custom, correct procedure
Tūpuna	Ancestors
Wai	Water
Wai Māori	Freshwater
Waiora	Health
Wairua	Spirit
Waka	Canoe
Wawata	Aspirations
Whainga	Common purpose
Whakapapa	Genealogy
Whakaaro	Thoughts
Whānau	A family group that consists of individuals who typically share a common whakapapa and identify with a common living or recent ancestor
Whenua	Land
Urupā	Burial site/s

Executive Summary

Background

Deliberate (supported by The Whetū Group), was commissioned to facilitate the pilot 'systems mapping' process for the Sustainable Seas National Science Challenge (the Challenge) Phase I Cross Programme 2.1 'Learning what EBM could look like in Tasman and Golden Bays research project' (CP2.1), that focussed on the decline of scallops. The purpose of CP2.1 was to explore whether systems mapping, an approach based on Systems Thinking (or more specifically the qualitative tools from the discipline of System Dynamics), may be useful in marine Ecosystem Based Management (EBM).

Participants in the CP2.1 project were selected based on either their institutional, (i.e. they were from a Crown agency, council of research institute) science knowledge and/or their ability to provide Māori perspectives. However, the iwi members who attended the first CP2.1 workshop were cautious and unsure about sharing their Māori perspectives within a non-Māori approach/tool and exited that process. There had been little pre-engagement between project management and the facilitator to socialise the CP2.1 pilot project, the systems mapping tool, and the relationship of this project between the Challenge, Iwi, Crown agencies, Councils and other Challenge projects within Te Tau Ihu. They were also unsure of the relevance, application, and benefit of the systems mapping tool, particularly at the interface of Crown and Council natural resource decision making processes.

As a result, the Challenge retained Deliberate (initially supported by The Whetū Group for this process) to engage with the Pou Taiao (Resource Management Manager, Ngāti Tama ki Te Waipounamu Trust). Consequently, the Pou Taiao, whānau participants and Māori scientist (who participated in the CP 2.1 project) entered an additional pilot 'systems mapping' process facilitated by Deliberate.

Audience

This report is intended for multiple audiences. While this is primarily the Challenge and Māori (whānau/hapū/iwi), it also offers natural resource management decision makers – inclusive of Māori, a pilot project that utilised a qualitative 'systems mapping' tool to explore some of the whānau perspectives relating to the decline of scallops (interchanged with kaimoana) within Te Tai-o-Aorere ki Mohua (Tasman and Golden Bays).

Project context

The trial workshop process and resulting 'systems map' described in this report is situated within the research project CP2.1 and initially the same focus issue - the decline of scallops within Tasman and Golden Bays. However, the whānau had reservations about focusing only on scallops, as there is an urgency to address the degradation of Te Tai-o-Aorere ki Mohua in its entirety.

With discussion and shared understanding the whānau agreed to participate in the project and inform development of the 'Systems mapping tool' (referred hereafter as causal loop mapping) relating to the decline of scallops that would interchange with the decline of kaimoana within Te Tai-o-Aorere ki Mohua.

The whānau participants involved in this project whakapapa to various Te Tau Ihu Iwi, as such their mātauranga and lived experiences are placed based and unique to their specific rohe within Te Tai-o-Aorere ki Mohua. Accordingly, they agreed to focus on a set of shared te ao Māori values and perspectives for the causal loop mapping process.

The whānau can draw valuable knowledge from te ao Māori and te ao Pākeha. Given the work undertaken in the CP2.1 project there was consensus not to explore anthropogenic and biological factors that whānau believe influence the decline of scallops within Te Tai-o-Aorere ki Mohua.

Objective

This report provides a brief introduction to the causal loop mapping tool and summarises the trial workshop process that whānau participants undertook with the facilitator to share their te ao Māori values and perspectives of influences affecting scallops (interchanged with kaimoana) within Te Tai-o-Aorere ki Mohua. It also presents some key recommendations.

Method

The work described in this report draws on a qualitative case study approach. This enabled a level of flexibility to suit the context and objective of this pilot project rather than the methods of inquiry used. This process was primarily informed by the causal loop mapping facilitator's experience and the naturally occurring sources of interactions and knowledge of the authors and whānau. In this report, observational descriptions of the workshop process and insights are reported by the authors.

Pilot causal loop map – key learnings & recommendations

The pilot causal loop map is shown in Figure 1 (an A3-sized map is available on page 71). The visual representation and general 'flow' of the map i.e., top left to right depicts the defining te ao Māori principle – whakapapa and the interconnected and holistic relationship of the four key areas that nest cultural values, and perspectives.

Casual loop mapping was able to:

- Visualise the interconnectedness of the spiritual, physical health and wellbeing relationships between Ranginui me Papatūānuku, Ngā Atua, Ngā Atua Kaitiaki, Tāngata Whenua through whakapapa and how a change in the health and wellbeing of one will result in a similar change in the health and wellbeing of the others.

- Highlight the degradation of species or resources involves recognising the broader implications for the entire ecosystem and human communities.

- Demonstrate that there are layers of qualitative and quantitative knowledge.

- Visualise a more holistic understanding of Te Ao Māori, and legal and ecological "systems" and their interconnections as understood by Te Tai-o-Aorere ki Mohua whānau.

- Support shared understanding about the actions required to move toward desirable alternative futures. The causal loop map is a tool to explore potential changes over time.

The findings are outlined according to: Whakapapa; Four key causal loop map areas - Ngā Hononga Taiao, Hononga Kai, Te Tiriti o Waitangi and Fisheries Management Legislation; Possible Futures; and a Summary of learnings and recommendations resulting from the pilot causal loop mapping process.

Whakapapa

Whakapapa is at the heart of the causal loop map. Whakapapa is the genealogical lineage and connection to 'Ranginui me Papatūānuku', their many children – 'Ngā Atua', and the divine processes that physically manifest in te Taiao (the natural world) including all living and non-living resources. It is through whakapapa to ngā atua, (including Tangaroa - atua of the sea, rivers, lakes and creatures that live within them) that Tāngata Whenua (the whānau within this project) inherit their birth right and duty as kaitiaki of their respective rohe that includes Te Tai-o-Aorere ki Mohua. Therefore, degradation of one species or resource is understood in terms of the negative impacts to the whole living system and to people themselves.

Figure 1.   Pilot causal loop map – a whānau perspective for Te Tai-o-Aorere ki Mohua

Four key areas

There are four key areas that nest cultural values and perspectives within the causal loop map:

1. **Ngā Hononga Taiao (red title):** Whakapapa and obligations to uphold and nurture the interconnected spiritual and physical relationships of Ranginui me Papatuānuku, Ngā Atua, te Taiao (the natural world) and Tāngata Whenua.

   Mātauranga encapsulates te ao Māori, and interrelationships support te Taiao and Tāngata Whenua wellbeing, necessitating the exercise of kaitiakitanga as an expression and demonstration of tino rangatiratanga. This is a reciprocal relationship as tino rangatiratanga and Mana Whenua and Mana Moana provides the authority for kaitiakitanga to be exercised.

   Tiakina te Taiao (orange title) – respect and nurture te Taiao in accordance with kawa and tikanga customary practices.

2. **Hononga kai (red title):** The loops in this area focus on the provision of scallops/ kaimoana, a fundamental tāngata whenua value, right and practice. It highlights the priority aspirations for whānau, marae, hapū and iwi which is to uphold the mauri of Te Tai-o-Aorere ki Mohua. It recognises the rights of tāngata whenua to exercise kaitiakitanga, manaakitanga and decision making to maintain a healthy and sustainable supply of scallops/kaimoana.

   Manaakitia te whānau (orange title) – manaakitanga and acts of caring for and giving scallops/kaimoana to support the wellbeing of other whānau, hapū, iwi, manuhiri.

   Manaakitia te hapori (orange title) – manaakitanga and acts of caring for and giving scallops/kaimoana to support and care for the wellbeing of the wider community.

3. **Te Tiriti o Waiangi (red title):** The foundation for this area is Te Tiriti o Waitangi (the te Reo Māori version), including components that refer to The Treaty (the English version), as the Crown and Councils operate within the principles of the Treaty. The whānau assert that Te Tiriti o Waitangi guarantees tino rangatiratanga (full self-governance, full self-management, and full self-determination) and establishes an enduring partnership between Māori and the Crown.

   In contemporary environmental management, this partnership necessitates shared responsibility for co-governing and co-managing te Taiao – the Crown fulfilling statutory

obligations and Māori exercising kaitiakitanga. The whānau also affirm tino rangatiratanga is essential for the full practice of kaitiakitanga, as self-determination and authority are interdependent.

This interconnected area of loops ultimately influence the wellbeing of te Taiao, Tāngata Whenua and wider communities. However, barriers such as the intergenerational and ongoing impacts of colonisation and institutional racism hinder kaitiakitanga and tino rangatiratanga. Protecting the mauri of te Taiao requires co-governance and co-management within Te Tiriti frameworks, demanding urgent and decisive action.

4. **Fisheries legislative management (red title):** This area is connected to the Te Tiriti o Waitangi loops, representing the settlement of fisheries claims through key legislative instruments i.e., the 1992 Deed of Settlement that is implemented through the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992, the Fisheries Act 1996 and the Māori Fisheries Act 2004.

The loops depict Māori rights and interests in fisheries while also highlighting the legislative levers or barriers impacting whānau, hapū and iwi. For example, the need for mātauranga Māori to inform fisheries management; commercial fishing allocation limits through the Quota Management System are negatively perceived by whānau due to their experience and the state of fisheries. Further barriers include processes that continue to minimise whānau and hapū participation in local fisheries governance and management.

The whānau also discussed the artificial separation between customary and commercial fishing and prioritise customary take/allocation over recreation and commercial take within the causal loop map. They recognise the important role of recreational fishing for Māori coastal communities, contrasting it with the activities of those who fish without understanding or respecting the kawa and tikanga in the rohe moana.

Ultimately, the effective management of fisheries under Te Tiriti necessitates legislative frameworks and management practices that genuinely uphold kaitiakitanga.

Potential futures

The whānau conveyed the need to identify and understand different actions to help address the decline of scallops/kaimoana within Te Tai-o-Aorere ki Mohua. While this was not able to be piloted with the whānau, the authors tested a range of alternative possible futures using the causal loop map approach outlined in Section 8 of this report.

The process begins with a focus on the challenges being addressed as an articulation of trends of behaviour over time (in this case an historic decline in the health of kaimoana within Te Tai-o-Aorere ki Mohua). The causal loop map was then used to track the causal influences understood to be affecting the health of scallops/kaimoana, and graphs were sketched to support discussions about and potential interventions that could address the degradation of kaimoana within Te Tai-o-Aorere ki Mohua. See Figure 2 for an example (large diagrams on pages 61)

Natural resource problems and their management processes are most often informed by scientific methods of future scenario testing that use various types and complexity or analytical inference under different management scenarios. Therefore, increasing capability and accessibility to qualitative tools, whilst appropriately enabling te ao Māori values and perspectives to be identified and explored is critical to improve health of scallops/kaimoana within Te Tai-o-Aorere ki Mohua.

This project has shown how important it is to create an empowering Māori (whānau, hapū, iwi) approach and space for the whānau to familiarise and explore the causal loop mapping tool. Consequently, the two CP2.1 causal loop maps present a potential cross-cultural approach to understanding the influences on scallops/kaimoana within Te Tai-o-Aorere ki Mōhua.

To build on these causal loop maps it would be useful to identify a full suite of restorative scenarios and actions over time that are required to reduce key areas/pressures. Together, they could support deeper understanding of the decline of scallops/kaimoana and provide a common evaluation and reference system that could inform more quantitatively complex models. Finally, using the causal loop map to explore possible futures is a critically important intent of the approach and the process should always end with some version of this.

Figure 2.   Using the casual loop map to envisage potentially different futures
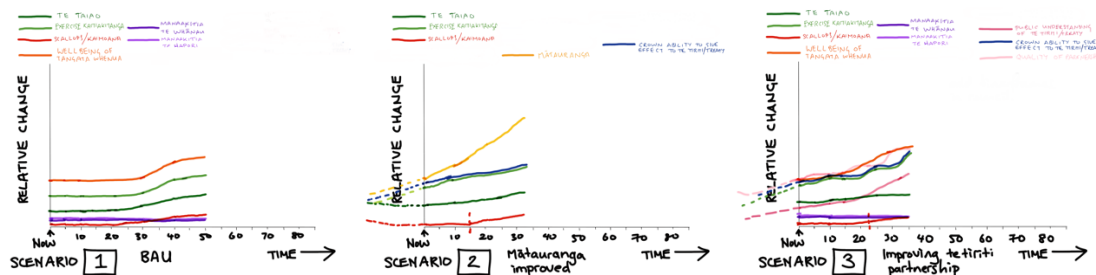
In addition to being used to explore possible futures via 'analogue simulation', causal maps may also: provide a common reference and evaluation system that can be applied across multiple tools; include te ao Māori values and mātauranga; and potentially enable feedback mechanisms to and from other methods, including more quantitative computer simulation models.

Summary of learnings and recommendations resulting from the pilot causal loop mapping process.

A summary of learnings from this process has been collated in the table below. Adjacent to them are a set of recommendations for how to best use the causal loop mapping process and/or the insights gained from this pilot process. The recommendations below are a mix of specific and generalised recommendations for the Challenge to consider.

Table 2. Summary of learnings and recommendations from the pilot causal loop mapping process

Learnings	Recommendations
Co-design, Co-development and Te Ao Māori commitment: Any future causal loop mapping with whānau, hapū and iwi necessitates a Māori approach and commitment to embed te ao Māori at its heart, recognise Te Tiriti o Waitangi, and create an empowering cultural space. It is important to apply good research practice when co-designing, and co-developing a project with whānau, hapū and iwi as offered in the Rauika Māngai, the Cross-National Science Challenge Māori Leadership guide to Vision Mātauranga (Rauika Māngai, 2019).	1. To ensure that research projects are relevant to whānau, hapū and iwi partners, they must be co-designed, co-developed and appropriately resourced.
Context: Hapū and iwi are confronted daily with an excess of proposals e.g., natural resource use, development, and research requests. At a strategic level, there was a lack of understanding and trust by some whānau	2. Challenge research projects and potential tools like causal loop maps need be situated within the specific cultural context of the whānau, hapū, iwi research partners. 3. To build trust and confidence with Te Tau Ihu Iwi, the Challenge should share

Learnings	Recommendations
participants about the Challenge and how it may contribute to Te Tau Ihu Iwi priorities, issues and aspirations; and its relationship with the Crown agencies and Councils. The authors consider that causal loop mapping has the potential to build capability for cross-cultural dialogue. However, it is important to enable an empowering Māori approach and space for the whānau to familiarise and explore the tool and develop a shared understanding of the decline of scallops/kaimoana and future possibilities. It is also important to contextualise any actual or perceived limitations of this approach with whānau, hapū and iwi at the beginning of a co-design process. For example, to clarify if hapū and iwi are comfortable to inform a causal loop map with their mātauranga as the tool and language used is articulated and understood within the western science discipline of System Dynamics. The methodological approach of causal loop mapping requires components (e.g., mātauranga) to be identified in such a way that any change in them could be described as an increase or decrease. At times, this caused discomfort with the whānau as it required them to 'translate' and compartmentalise te ao Māori and their interrelationships into 'components' that can go up or down. There is a range of influence and ability that Māori and non-Māori practitioners have to enable the inclusion of mātauranga within modelling processes e.g., whānau, hapū, iwi having no involvement in modelling; being general participants in collaborative modelling processes; including mātauranga within a western science conceptual model; penultimate development of a te ao Māori approach. As a qualitative tool, causal loop mapping can help explore possible futures from the map, via informal 'analogue simulation' that may also provide a common evaluation and reference system that includes te ao Māori values and mātauranga and enable feedback mechanisms from more quantitative computer simulation models. It is also important to acknowledge that there can be a limit to the number of 'inputs' and 'outputs' in a causal loop map, as more complex and detailed maps can be difficult to interpret. The strength of information could be limited, as there may be selection biases or subjectivity with elicited opinions.	the Te Tau Ihu project outcomes in a manner that can contribute to Te Tau Ihu Iwi priorities, issues and aspirations. 4. It would be helpful to situate causal loop mapping approach within a high-level overview of the suite of marine management tools/models that are currently contemplated through research or applied in Aotearoa/NZ marine management processes e.g., spectrum of qualitative to quantitative tools, purpose, how it works, complexity, uptake, advantages, limitations.

Learnings	Recommendations
Whanaungatanga: If there is no prior relationship between whānau, hapū, iwi, facilitator/researchers, time and care will be required to build trust and understanding of each other's backgrounds and roles in order to agree research objectives, tasks and process.	5. Research (by the Challenge or other providers) need to invest time to establish and build familiarity/trust between participants, facilitators, and researchers. 6. Guidance is needed on appropriate engagement, co-design/co-development, and implementation of research with whānau, hapū, iwi.
Complimentary project team: The team needs to include members who are culturally and subject area competent. This would enable rich dialogue between the whānau and facilitators to build on a platform of shared understanding in workshop settings.	7. Projects of this nature require co-facilitators who are ideally culturally and subject area (e.g., causal loop mapping) competent. 8. There needs to be a pre-requisite for facilitators to at least have an understanding of te ao Māori values and perspectives to aid quality discussion. This level of understanding is likely to vary - especially amongst non-Māori facilitators. A co-design and co-development process would identify the cultural competency level of the team and support that may be required.
Inadequate timeframe and budget: There were compressed timeframes to implement the workshops, introduce new tools and language to the whānau and explore their application. The whānau had to help build the cultural capability of the facilitator through the process (and vice versa for the facilitator to build causal loop mapping tool capability). The authors and whānau acknowledge that there was some budget for whānau participation and co-author roles.	9. As above, to ensure that projects are relevant to whānau, hapū, iwi partners, they must be co-designed, co-developed and appropriately resourced. This would have enabled a better research process and shared learning.
Final causal loop map debrief: Time and resource pressures did not allow for a debrief of the final causal loop map tool with the whānau. This should still be held to go over the results of the trial causal loop map and to check for understanding, relevance, and application for whānau to evaluate the benefits of the tool.	10. If desired by the whānau, a debrief should be held to go over the final system map and to check for understanding, limitations and application in their respective work.

Learnings	Recommendations
Communication tools: The causal loop map is considered a useful tool by the authors. However, it is not a Māori-centred decision support tool and it can be overwhelming as a single image and difficult to understand if people are not familiar with the approach. It is best understood when explained in narrative and accompanied by anecdotes of how factors interact and influence behaviours and trends. The lead facilitator 'held the pen' with regards to the causal loop mapping tool computer application. As such any small or large changes e.g., due to misinterpretation or spelling had to be communicated to and actioned by the lead facilitator.	11. Communication tools that support both the process itself, as well as disseminating the outputs for whānau, hapū, iwi need to be developed e.g., story map, audio-video explanations and narratives for different parts of the map and the insights it provides. This will help to explain the causal loop map, to see it, hear it, feel it. 12. Explore the potential to enable shared access for project leaders/facilitators to the causal loop mapping tool computer application.
Given challenges, this pilot was only able to progress with the development of the causal loop map itself. Generating qualitative insights about different possible futures from the map, via informal sketched temporal graphs (referred to in the report as 'analogue simulation') supported by rich discussion, were not completed in this pilot. This is an important step in the process of causal loop mapping and should not be neglected because it ties the process and the resulting causal loop map back to exploring anticipated or desired changes over time. It can also help provide a common evaluation and reference system that could inform more quantitatively complex models.	13. Ensure that the causal loop map is used as a way to support kōrero around possible futures. The map is a tool to support these kōrero and this needs to be better understood at the beginning, by both sponsors and participants, as a key outcome. This helps leverage the understanding of causality jointly developed into an outcome of shared understanding of potential actions required to move into a more desirable potential future. 14. Consideration should be given to running temporal graphing or 'analogue simulation' sessions with the whānau participants and/or others, to demonstrate the use of the tool and explore alternative futures. 15. Explore the potential to co-design and co-develop a 'whole cycle' qualitative (causal loop map) and selected quantitative approach on an issue with whānau, hapū, iwi and/or others. The causal loop map could be used as a common evaluation and reference system that could inform more complex quantitative computer simulation models.

1 Introduction

The Sustainable Seas National Challenge (the Challenge) research seeks to address the question: How can we best develop our marine economy, while protecting the taonga of our marine environment? To help achieve this the Challenge research focuses on: i) improving marine resource decision-making and the health of our seas through Ecosystem Based Management (EBM)[1] and ii) transforming New Zealand's ability to enhance our marine economy into a blue economy.

This report summarises the 'Piloting the use of Systems Mapping in the Sustainable Seas National Science Challenge – Causal Loop Mapping Pilot – a whānau perspective for Te Tai-o-Aorere ki Mohua. It is part of the Challenge's 'Learning what EBM could look like in Tasman and Golden Bays research project' (CP2.1) that focussed on the decline of scallops. The purpose of CP2.1 was to explore whether systems mapping, an approach based on Systems Thinking (or more specifically the qualitative tools from the discipline of System Dynamics) may be useful in marine Ecosystem Based Management (EBM).

Participants in the CP2.1 project were selected based on either their institutional knowledge (i.e. they were from a Crown agency, Council or research institute) science knowledge and/or their ability to provide Māori perspectives. However, the iwi members who attended the first workshop were cautious and unsure about sharing their Māori perspectives and exited the project. There had reportedly been little prior relationship building with Te Tau Ihu Iwi, or pre-engagement between project management and the facilitator to socialise the CP2.1 project, the systems mapping tool, and the relationship of this project between the Challenge, Iwi, Crown agencies and Councils.

As a result, the Challenge retained Deliberate (initially supported by The Whetū Group for this process) to engage with the Pou Taiao (Resource Management Manager, Ngāti Tama ki Te Waipounamu Trust). Consequently, the Pou Taiao, whānau participants and Māori scientist (who participated in the CP 2.1 project) entered an additional pilot 'systems mapping' process facilitated by Deliberate (see section 3 for more details).

1.1 Objective and writing convention

This report provides a brief introduction of the causal loop mapping tool and summarises the trial workshop process that whānau participants undertook with the facilitator to share their te ao Māori values and perspectives of influences affecting scallops (interchanged with kaimoana) within Te Tai-o-Aorere ki Mohua.

Causal loop mapping is an approach based on Systems Thinking (or more specifically the qualitative tools from the discipline of System Dynamics) and may be useful in Ecosystem Based Management (EBM) (Connolly, 2019). The term causal loop map is used throughout this report for ease of reference and because the term 'system' was a source of confusion for some people (see section 6.1 for a discussion of this confusion from the first workshop).

The overall intent of the project was to explore the potential application of causal loop mapping and help support cross-cultural dialogue. It is a tool that can also support learning at the intersection of different perspectives.

Te reo Māori is contextual as well as metaphorical and there are often several translations, interpretations, meanings that can be understood for a single Māori word. The context of how te reo

---

[1] EBM is defined as a holistic and inclusive way to manage marine environments and the competing uses for, and demands on, the ways New Zealanders value them. This has been a focus of research in the Sustainable Seas National Science Challenge. For an outline of Ecosystem Based Management as defined by the Challenge, see Appendix 3.

Māori kupu are used is therefore important. Generally English is specific in is definition. Te reo Māori and English words that may require definitions throughout this report are provided in the glossary section. Some Māori words and cultural values can translate into English and hold their meaning, however, some translations do not reflect the full significance and depth of meaning. Guidance was drawn from literature to provide further interpretations for some Te reo Māori kupu.

We refer to whānau, hapū and iwi throughout this report and the Tangata Whenua ki Te Tau Ihu participants as 'whānau' to reflect their knowledge and expertise as haukainga and kaitiaki within their rohe for marine and environmental management. It is also important to acknowledge that the whānau involved in this project whakapapa to various Te Tau Ihu Iwi, therefore their mātauranga and lived experiences are placed based and unique to their rohe. Accordingly, they agreed to focus on a set of shared te ao Māori values and perspectives for the causal loop mapping process and the cultural narratives within sections 4, 5 and 7 are provided by Ngāti Tama ki Te Waipounamu. Te Ao Māori was not explored to great depth due to resource and process limitations. As an example, more whānau could have been engaged, particularly those further versed within te reo me ōna tikanga.

Given the work undertaken in the CP2.1 project there was consensus not to explore anthropogenic and biological factors that whānau believe influence the decline of scallops within Te Tai-o-Aorere ki Mohua.

1.2 Caveats underpinning this report

The following caveats underpin this report:

- While the authors believe that causal loop mapping may be a versatile tool that can map and visualise te ao Māori values and perspectives, it is not a Māori-centred decision support tool and does not represent the depth of te ao Māori. However, this tool has been piloted to test whether it can assist hapū and iwi to inform cross-cultural dialogue, decision making processes and articulate some of their te ao Māori values and perspectives in a way that retains integrity and meaning.

- It is not the intention of this report and causal loop map to detract from, or substitute in any form, the distinct perspectives of whānau, hapū, and iwi of Te Tau Ihu o Te Waka a Māui - ko te mana motuhake e ngā iwi o Aotearoa, and any respective outputs, actions or initiatives produced by whānau, hapū, iwi regarding Te Tai-o-Aorere ki Mohua. The whānau participants and authors respect that there is no 'one' Māori world view.

- The whānau involved in this project whakapapa to various Te Tau Ihu Iwi, as such their mātauranga and lived experiences are placed based and unique to their specific rohe within Te Tai-o-Aorere ki Mohua. Accordingly, they agreed to focus on a set of shared te ao Māori values and perspectives for the causal loop mapping process.

- The whānau can draw valuable knowledge from te ao Māori and te ao Pākeha. Given the work undertaken in the CP2.1 project there was consensus not to explore anthropogenic and biological factors that whānau believe influence the decline of scallops within Te Tai-o-Aorere ki Mohua.

- We draw on existing published and readily discoverable Te Tau Ihu based literature, particularly the He Pou Tokomanawa – Kaitiakitanga in Practice report (Sunde et al., 2019) and the Ngāti Tama Environmental Management Plan (2018).

1.3 A report for multiple audiences

This report is intended for multiple audiences. While this is primarily the Challenge, natural resource decision makers - inclusive of whānau, hapū, iwi, it has also been written with a lay audience in mind. Writing for such a broad audience was challenging for the authors.

It is fundamentally important not to dilute or mis-translate te reo Māori and te ao Māori values, perspectives. Some explanation about this is provided in section 5. In some sections, the report introduces concepts and theory that may be new to respective audiences.

Therefore, to help make the report more accessible, summary information boxes are provided at the beginning of each section or sub-section, where relevant. An example of this is shown in Figure 3. These boxes are intended to provide a high-level summary of the information in each section, to enable the reader to get a sense of the information contained within.

Figure 3.   Example information box used to summarise each section in this report

> *Summary:*
>
> - *Text boxes like this may provide summary information at the beginning of each section.*

1.4 Structure of this report

This report is structured as follows:

- The introduction to causal loop mapping (section 2);
- Summary of the journey to this causal loop mapping pilot (section 3);
- Te Tai-o-Aorere ki Mohua (Golden Bay and Tasman Bay) (section 4);
- Te Ao Māori values – causal loop map (section 5);
- Description of the co-learning experience (section 6);
- A description of the causal loop map (section 7). This section outlines key areas of the map as well as providing a narrative for the causal connections visually described in the map;
- Section 9 describes how this causal loop map may be interpreted in conjunction with the map produced in the earlier pilot;
- Having described the map in detail, some consideration is then given to how this can be used to explore and inform different possible futures (section 8). This provides a perspective on the 'so, what now?' question;
- A summary of the process and insights is described and a series of recommendations are provided (section 9).

2 What is causal loop mapping?

Summary:

- **Causal loop mapping as used in this report, is a qualitative tool from the discipline of System Dynamics**
- **It helps visualise (map out) the complex and interconnected nature of causality relating to issues of interest**
- **This increases our understanding of the causality behind these issues, enabling us to better take more appropriate action/management decisions**

The world that we live in is a highly interconnected place of causality and effect. The work of policy development often seeks to respond to undesirable behaviour or patterns being experienced in our natural environment and therefore seeks to influence these causes, to alter or improve the desired behaviour.

'Systems Thinking' is a name often applied to a range of approaches to thinking about issues holistically. One of these approaches is academic discipline of 'System Dynamics'. System Dynamics originated from the Sloan School of Management at the Massachusetts Institute of Technology, Cambridge, Massachusetts in the late 1960's.

Systems thinking, as described by the discipline of System Dynamics, is a conceptual framework and set of tools that have been developed to help make these patterns of interconnectedness clearer (Senge, 1990)[2]. They help us understand the structure of a set of various interacting causal factors that influence a behaviour that we are trying to understand. Once these interconnections are articulated in a system map (or causal loop map as described in this report), we can better understand which parts of a system are having the most influence on the behaviour, allowing us to identify (usually a combination of) areas of leverage where action could be expected to influence this.

Where the term causal loop mapping has been used in this report, it refers to the qualitative tool of that name (causal loop diagram or causal loop map) articulated by the discipline of System Dynamics (Sterman, 2000). The term causal loop map is used throughout this report for ease of reference and because the term 'system' was a source of confusion or frustration for some participants (see section 6.1 for a discussion of this from the first workshop).

System Dynamics was developed at the Massachusetts Institute of Technology. Image credit web.mit.edu

---
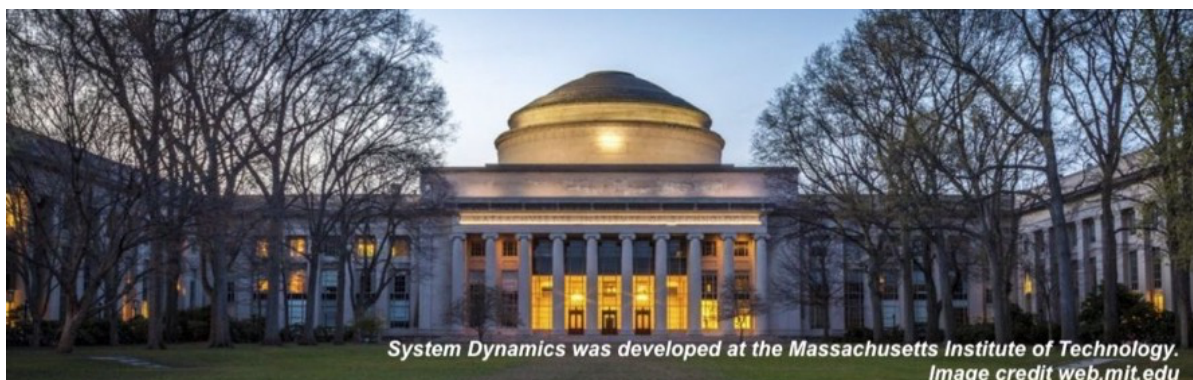
[2] For a detailed introduction to the concepts of Systems Thinking, the reader is referred to *The Fifth Discipline – the art and practice of the learning organisation* by Peter Senge (1990) as an accessible introduction.

3 The journey to this causal loop map pilot

Summary:

- *The iwi members who attended the first CP2.1 workshop were cautious and unsure about sharing their Māori perspectives within a non-Māori approach/tool and exited that process. There had been little pre-engagement between project management and the facilitator to socialise the CP2.1 trial project, the systems mapping tool, and the relationship of this project between the Challenge, Iwi, Crown agencies, Council, and other Challenge projects within Te Tau Ihu. They were also unsure of the relevance, application, and benefit of the causal loop mapping tool, particularly at the interface of Crown agencies and Council decision making processes.*

- *The Challenge retained Deliberate (initially supported by The Whetū Group for this process) to engage with the Pou Taiao (Resource Management Manager, Ngāti Tama ki Te Waipounamu Trust). Consequently, the Pou Taiao, whānau participants and Māori scientist (who participated in the CP 2.1 project) entered an additional systems mapping process (causal loop mapping) facilitated by Deliberate.*

- *This project is not an example of best co-design and co-development research with Māori, however the authors consider that causal loop mapping has the potential to help cross-cultural communication and decision-making to achieve positive restorative outcomes for Te Tai-o-Aorere ki Mohua.*

In late 2018 Justin Connolly from Deliberate implemented a pilot 'systems mapping' (in this report 'causal loop mapping') process for the CP2.1 project of the Challenge. This sought to trial whether causal loop mapping, an approach based on Systems Thinking (or more specifically the qualitative tools from the discipline of System Dynamics)[3] could be useful in EBM. The iwi members who attended the first CP2.1 workshop expressed their discomfort with the research engagement process and how Māori perspectives might be sought and incorporated into the causal loop mapping process including a rejection to integrating te ao Māori values i.e., kaitiakitanga by non-Māori into a non-Māori framework.

To help resolve the situation the Māori scientist (who was a participant at this workshop) suggested that the Challenge may like to consider holding another pilot causal mapping process with Te Tau Ihu Iwi. The Challenge retained Deliberate (initially supported by The Whetū Group) to engage with the Pou Taiao (Resource Management Manager, Ngāti Tama ki Te Waipounamu Trust).

Consequently the Pou Taiao, whānau and Māori scientist (who participated in CP2.1) participated in this pilot causal loop mapping process that started in August 2019. A subsequent workshop session was facilitated by Deliberate in September 2019. To help refine the causal loop map, working sessions followed through October 2019, November 2020, March 2021 and July 2021.

The workshop process focusses on the same issue that was explored in the CP2.1 initial pilot – the decline of scallops in the Tasman Bay and Golden Bay area[4]. However, this was a strong point of contention during the August and September 2019 workshops for this project.

---

[3] 'Systems Thinking' is explained in a previous report by Deliberate outlining the proposed approach for this pilot. For further detail refer to – *Conceptual options for incorporating Systems Thinking into Project CP2.1 of the Sustainable Seas National Science Challenge*. Much of this explanation is also recreated in Appendix 1.

[4] Much of the Sustainable Seas EBM case studies have explored the declining sea-bed health (acknowledging it may have passed a tipping point) in the Tasman Bay and Golden Bay (TBGB) area. Some projects looked specifically at the decline in scallops in this area (at time of writing the fishery

Whānau were concerned about how (if at all) te ao Māori values and perspectives might be applied within an Eurocentric framework. It was felt by some whānau that te ao Māori values and perspectives were unlikely to be fully appreciated and would be forced to fit into 'yet another' western science paradigm. Further, Step 1 within Systems Dynamics (see Appendix 1 and Appendix 2) is 'Problem articulation' i.e., 'the decline of scallops'. Starting from a negative frame was incongruous for whānau and it was also difficult to focus only on scallops given that all natural resources within their cultural context - Te Tai-o-Aorere ki Mohua (as opposed to Tasman Bay and Golden Bay) are important for whānau, hapū and iwi.

The September 2019 workshop enabled whānau to 'get to know' the facilitator and engage in open dialogue about the research project and tool. The whānau also shared their extensive experience of engagement and participation with Crown agencies and Councils to protect, enhance and restore the coastal marine environment and scallop recovery in Te Tai-o-Aorere ki Mohua. Working sessions were required to support the facilitator to gain an understanding of te ao Māori and for whānau to refine the causal loop map.

It is also important to note that the original pilot CP2.1 project undertook pre-workshop/post-workshop surveys to explore how participants' understanding of the problem (the decline in scallops) may have changed. None of these surveys were undertaken with the whānau for these workshops. This was due to a range of reasons including: the constraints on time and resources; the fact that whānau had no pre-engagement for this project and because the two maps are not directly comparable therefore the value of any data gathered by such a survey would be negligible. Additionally, as described (from the point of view of the facilitator of that process) in the CP2.1 report of the process (see Deliberate, 2019) the original pilot was undertaken within constrained time; it was unclear (both to the facilitator and participants) how it fitted in with other research being undertaken by the Challenge in the Tasman Bay and Golden Bay area; and iwi representatives were likely experiencing 'research fatigue' – having been involved with many seemingly disparate research activities with unclear outcomes.

The project experienced delays for several reasons including the initial apprehension of whānau, to the value and application of the causal loop map tool to aid the practical recovery of scallops within the Tasman Bay and Golden Bay area. This apprehension was informed by the extensive experience of whānau working with Crown agencies, Councils and systems, a lack of pre-work on the relationship with the facilitator, exclusion of Māori in the research design process, cultural sensitivity of how mātauranga may be used by others, and limited engagement capacity of whānau because of competing priority iwi projects and timelines.

The whānau and Māori scientist experienced loss and wide-ranging effects of COVID-19 upon their whānau, hapū, and iwi communities during course of this project. Further, given that the research framing did not originally start from a co-designed, co-developed position, a negotiated space of learning had to essentially be retro-fitted to help whānau understand the purpose of this pilot and share different perspectives about the issues contributing to the loss of scallops. The Māori scientist was a key support person for the whānau, Pou Taiao and facilitator. She had an established and trusted research relationship with many of the whānau and had already engaged on a different Challenge Māori research project. She was also a participant in the pilot CP 2.1 project and that enabled her to offer insights to the whānau on the causal loop map process and potential usefulness of the tool.

---

had been closed for over 10 years). To align with existing research, the original pilot and these subsequent Māori workshops were focused around this same subject matter.

4 Te Tai-o-Aorere ki Mohua

Summary:

- *The project refers to the decline of kaimoana in Te Tai-o-Aorere ki Mohua.*

- *Te Tai-o-Aotere ki Mohua have sustained generations of whānau and hapū, evidenced by numerous kāinga and pā, wahi tapu and urupā along the coastline.*

- *The coastline was the major transport route for waka and Māori settlements.*

- *Customary harvest and access to kaimoana and taonga species are central to whānau and hapū life, health and wellbeing.*

Te Tai-o-Aorere ki Mohua are viewed as a living being; an indivisible whole incorporating the awa that flow and all its physical and metaphysical elements. Te Tai-o-Aorere ki Mohua are significant coastal marine environments located in Te Tau Ihu, formally referred to as Te Tauihu o te Waka a Māui (the prow of Māui waka). The cultural narratives and whakapapa of whānau are embedded in the rohe and includes:

- Ko ngā maunga: Parapara, Pukeone, Tuao Wharepapa and Maungatapu;

- Ko ngā awa Pariwhakaoho, Motueka, and Wakapuaka;

- No ngā moana Te Tai-o-Aorere, Mohua, and Horoirangi

- Ko ngā waimātaitai/hāpua (estuarine areas): Paturau (within Onetāhua), Moutere and Wakapuaka; and

- Ko ngā whenua: Puponga, Te Tai Tapu, Pakawau, Parapara, Motupipi, Wainui, Kaiteriteri, Whakatū, Waimea and Wakapuaka

The coastal environment of Te Tai-o-Aorere ki Mohua have sustained generations of whānau and hapū, evidenced by numerous kāinga and pā, wahi tapu and urupā along the coastline that was also the 'main highway' for transportation by waka. Access to kaimoana and taonga species was central to whānau and hapū settlements to ensure sustenance, health and wellbeing and the growth and development of Māori communities (Passl, 2019).

5 Te Ao Māori – causal loop map

This section briefly te ao Māori values that the whānau discussed when developing the casual loop map. We provide an overview, as it is important for the audience to embrace te ao Māori and its diversity of perspectives when interpreting causal loop maps.

5.1 Whakapapa

Whakapapa is the genealogical lineage and connection to 'Ranginui me Papatūānuku', their many children – 'ngā atua', and the divine processes that physically manifest in te Taiao (the natural world) including all non-living and living resources. It connects whānau, hapū and iwi to each other, to te taiao and to ngā atua.

It is through whakapapa to ngā atua, including Tangaroa (atua of the oceans, rivers, waterways) and creatures that live within them) that tāngata whenua (the whānau within this project) inherit their birth right and duty as kaitiaki of their respective rohe that includes Te Tai-o-Aorere ki Mohua - therefore degradation of one species or resource is understood in terms of the negative impacts to the whole living system and to people themselves.

Whakapapa is central to te ao Māori and guides how whānau and kaitiaki interact with the natural world through the actions of kaitiakitanga[5].

5.2 Ngā Atua o te Taiao

Ngā atua kaitiaki and are spiritual guardians for the natural world. Tāngata whenua are descended from ngā atua and as kaitiaki must ensure the mauri (life force, mana and health) of their taonga. Tāngata whenua (the whānau within this project) have a duty to wisely use, manage and protect the bounty of Tangaroa and the natural world to ensure their own quality survival.

The cultural narratives of whānau and their relationship with te taiao and ngā atua kaitiaki continue to inform their practices, interests, associations, values and lives. See Appendix 5 for examples of ngā atua o te taiao.

5.3 Kaitiakitanga and Mauri

Kaitiakitanga is the duty arising from whakapapa to nurture and care for te Taiao (natural world) physical well-being and mauri. Whānau have the responsibility to carry out kaitiakitanga practices to manage and support the life force, mana and health of Te Tai-o-Aorere ki Mohua.

For whānau, a key management principle is to protect and enhance the mauri of Te Tai-o-Aorere ki Mohua so to provide for a healthy sustainable supply of kaimoana. They also affirm rangatiratanga (self-determination, authority) as kaitiakitanga can't be fully practiced without self-determination and authority. Kaitiakitanga has also been interpreted through legislation and by non-Māori that limits meaning to 'environmental stewardship' or 'guardianship' within a conservation context.

1.1.1. Kaitiakitanga and RMA

The following sections are whānau insights of how council decision makers regard kaitiakitanga in RMA processes.

> Council interpretation of 'kaitiakitanga' was limited to Māori engagement on 'natural resources' only. However,the Resource Management Act (RMA 1991) section 2 definition of kaitiakitanga is: "*the exercise of guardianship by the Tangata Whenua of an area in*

accordance with tikanga Māori in relation to natural and physical resources; and includes the ethic of stewardship".

The whānau interpretation of the RMA definition is that Māori should also be engaged on matters relating to activities that may impact on '*physical resources*' and physical resources owned by whānau, hapū and iwi. However, councils are not engaging with whānau, hapū and iwi on those matters.

Further, kaitiakitanga is also part of spatial planning for natural and physical resources. This pilot scallop causal map project was considered a form of spatial planning for spiritual and physical elements of te taiao. (P Rene pers comms 2021).

Another whānau participant also noted that the RMA definition for 'kaitiakitanga' should be strengthened to 'give effect to kaitiakitanga' and further adopted and implemented by all Crown agencies to ensure alignment and consistency of Māori engagement protocols (pers comm F Te Miha 2021)

There has also been criticism of the term 'resource' because it is underpinned by a western euro-centric knowledge system that puts natural resources subservient to human use and does not take into account Te Ao Māori values and priority to te taiao (pers comm I Shapcott 2019).

The report titled '*He Pou Tokomanawa Kaitiakitanga in Practice'* reinforces the perspectives held by whānau in relation to the meaning and context of kaitiakitanga. The focus of the research was to collate whānau mātauranga on environmental pressures that affect the mauri and ecological health of the moana and coastal areas in Te Tai-o-Aorere ki Mohua.[6] Whānau and hapū quotes of kaitiakitanga are encompassed as kaitiakitanga, guardianship, an inherent duty and reciprocity. These are shared as follows:

Kaitiakitanga:

"The meaning of kaitiakitanga for whānau includes guardianship; intergenerational responsibility; an inherited duty; moral hierarchy among beings; and mutuality, a duty of care and self-restraint. The interpretations of kaitiakitanga are well beyond the common English translation as 'guardianship'".

Guardianship:

"…protecting, preserving, not just our [fish] stocks, but also the moana in general." "You are the guardian of that resource, whatever you're talking about – come shellfish, finfish, whatever, seaweed, whatever. You are the guardian; you have the role as caretaker to care for it and help to look after it. That's my belief."

An inherited duty:

"It's in the blood." Interviewer: You don't have a choice, do you? "No, but I like it that way." "…kaitiaki is sort of engrained in us." "You feel a sense of obligation to look after things, and that's been a big force of where we come from…"

Reciprocity, a duty of care and self-restraint:

"Where things can't look after themselves, because of human impact, then we have a responsibility to do that. We can position ourselves as guardians and caretakers, like we've got to look after things in a pecking order, a bit like children, they need looking after. Well, actually, all of this just needs us to not harm it."

---

[6] He Poutokomanawa – Kaitiakitanga in Practice Ngāti Tama Report, Sunde C, Astewood J-R., Young A. 2019. Sustainable Seas National Science Challenge, Ministry of Business, Innovation and Empolyment. Tiakina te Taiao Report. 58p. Plus appendices.

The Ngāti Tama Environmental Management Plan also documents the relationship of Ngāti Tama with the natural environment in Te Tauihu. A key principle in this Plan is to ensure land and water activities deliver a net positive environmental outcome that enhances and protects the vitality of the life-supporting capacity of all living things.

1.1.2. Ki Uta ki Tai

Ki uta ki tai refers to managing the natural environment and activities taking into account the flow of water from the mountains to the sea. Whānau, hapū and iwi see the marine environment and its associated taonga species as interconnected with the terrestrial whenua (land) and waimāori/waiora (freshwater) ecosystems. Because the physical natural attributes and spiritual elements are intertwined and inseparable, the health of the whole system reflects the wellbeing of tāngata whenua. Therefore, to safeguard the mauri of natural environments, all activities within catchments should be managed in an integrated way[7] - ki uta ki tai.

5.4 Kawa and Tikanga

Kawa are protocols/customs, and tikanga are cultural practices and behaviours. 'Tika' which means 'right', or the 'right' way to act in accordance with tikanga. For example, it is common cultural practice for whānau to return the first fish caught back to Tangaroa as an offering and thanks for the provision of fish. A rāhui is the tikanga that prohibits access to an area or resources. The whānau have initiated a self-imposed rāhui to take no fish from Te Tai-o-Aorere ki Mohua to enable fish stocks to replenish to sustainable levels.

Is a holistic perspective encompassing all aspects of knowledge and seeks to understand the relationships between all component parts and their interconnections to gain an understanding of the whole system. It is based on its own principles, frameworks, classification systems, explanations and terminology. Mātauranga Māori is a dynamic and evolving knowledge system and has both qualitative and quantitative aspects

5.5 Mātauranga

Mātauranga encapsulates te ao Māori.   It is a system of intergenerational knowledge, both spiritual and physical, and understanding of all things living and non-living that adapts and evolves with experiencing place-based relationships from generation to generation[8]. There are various forms of mātauranga, including and not exclusive to mātauranga a-iwi, a-hapū, a-whānau that are shaped according to the relationship between tāngata whenua and various ecosystems. Each whānau, hapū and iwi will have their own narrative experiences, learnings and customary practices that continues into the future. Mātauranga is a dynamic and evolving knowledge system.

5.6 Summary

Te Ao Māori values underpin Te Tai-o-Aorere ki Mohua pilot scallop/kaimoana causal map. For whānau, the state of the mauri of taonga species must be sustained, replenished and regenerated.

Ultimately, the health and wellness of the spiritual and physical domains of the natural world are inextricably linked to the ability of whānau, hapū and iwi to action kaitiakitanga. The outcome(s) of kaitiakitanga is to protect and safeguard the mauri and sustainable capacity of scallops, and other kaimoana. As a result, manaakitanga values enable provision of kai for whānau and communities.

---

[7] Ngāti Tama ki Te Waipounamu Trust Environmental Management Plan 2018
[8] Tiakina te Taiao, A Cultural Impact Assessment – managing waterways in the Tasman District, April (2011:8)

6 The co-learning experience

Summary:

- *Workshop 1 was characterised by:*
    - *Pre-work on relationship with facilitator, set the scene for EBM project, causal loop tool context and how these workshops linked to the Challenge*
    - *Relevance and application of tool to align with iwi priority to restore scallops and protect taonga species*
    - *As a result of informed discussion the focus was changed from the decline in scallop, to ability for whānau, hapū, iwi to tiaki te taiao and to manaaki whānau and community*
- *Workshop 2 (and subsequent working sessions) were characterised by:*
    - *Discussion on te ao Māori values, tikanga and kaitiaki roles, fisheries management*

In the first CP2.1 pilot project, observations of the process were provided in the report by the facilitator. In this follow-on pilot project, the observations described here are from the perspective of the facilitator and two of the participants/authors. If one of these roles is more relevant for a particular point of view, this has been noted.

Two workshops were originally intended for this pilot project, focusing on the issue of scallop decline. The intent was to remain consistent with the earlier pilot CP2.1 project and provide a consistent linking point between the output causal loop maps. For more details on this proposed approach, see Appendix 2.

The process resulted in two workshops then various subsequent working sessions. The two workshops were held with all whānau participants, and working sessions were attended by the facilitator, Ngāti Tama Pou Taiao, and the Marine Scientist – Te Kūwaha/NIWA, sometimes with an iwi participant to provide further context and information.

Workshop One was supported by the Māori scientist and Pou Taiao to enable the whānau and facilitator to get to know each other and to check-in on each other's understanding of the pilot project, tool and its relevance and application to whānau, hapū, iwi aspirations and outcomes. Workshop One was important to whānau as there was uncertainty about the usefulness of the causal loop mapping tool and if te ao Māori worldview and values were going to be understood and applied appropriately by the facilitator and in the map tool.

6.1 Workshop One

The first workshop was jointly facilitated by Justin Connolly (Deliberate) and James Whetū (The Whetū Group).

Because a significant period of time had passed since the first pilot in 2018, Workshop One provided an opportunity to backfill and 'reset' on how this process was designed and understood. This is partly why a revised approach to the workshop was taken and can be summarised as a sequential journey through the following four themes:

- A background of unknown overall view of the process and the wider Sustainable Seas National Science Challenge,

- A desire to understand how this approach fitted in within the wider context of Māori involvement in decision-making,

- Confusion from many interpretations of the word 'system', and

- Changing the focus of the causal loop map from the decline in scallops (interchanged with kaimoana) to the ability for kaitiaki to care for Te Tai-o-Aorere ki Mohua and uphold manaakitanga.

These key learnings are explored in the following sub-sections.

6.2 Subsequent meetings – Working sessions

Further iterations of the causal loop map tool were undertaken by the Pou Taiao and the Marine Scientist – Te Kūwaha/NIWA, to refine te reo Māori, cultural values and connections in conjunction with the facilitator. This process was necessary for shared learning and understanding of the causal loop map tool and the whānau cultural context and values.

6.2.1 Background

At the beginning of workshop one, participants shared their frustration with this pilot process, and the wider design of the Challenge. This resulted in some robust and frank discussions.

This frustration was based on multiple matters. There had been little communication about what the workshops would entail before the event, something that the lead facilitator acknowledged. There was also frustration that there was an expectation of discussing te ao Māori values and perspectives in the CP2.1 workshop, when it was not considered an appropriate or safe space for/by the iwi participants. Finally, there was frustration (as noted in the report on the first pilot) that the multiple projects within the Challenge were not coordinated and there was no clear understanding about how or if they fit together. Many whānau were also experiencing 'research fatigue', having been involved in many research projects before this one (not just relating to this Challenge).

6.2.2 Understanding how this approach fits in within the wider context of iwi involvement in decision-making

It was important for the whānau to understand the value of this pilot and whether it could support Iwi to uphold their te ao Māori values and perspectives when participating in Crown agency and Council decision making processes for Te Tai-o-Aorere ki Mohua. Further, how this pilot may assist Iwi efforts for implementation of action on the ground to enhance and restore the mauri of scallop habitats and taonga species in the coastal marine environment.

The whānau shared their extensive and proactive kaitiakitanga actions to strengthen their relationships with Te Tai-o-Aorere ki Mohua – the coastal marine environment, waterways, lands and also by participating in Crown and Council processes.

The participants noted the frustration and fatigue they have with Crown and Council systems and structures that operate in silos with different baseline processes and different governance and management standards for te Taiao including fisheries management. Further, the inadequate engagement processes that undermine tino rangatiratanga and kawanatanga relationship between the Iwi and Crown as Te Tiriti partners.

The facilitator explained and demonstrated the systems structure context and tool, so as to help the whānau determine the usefulness of this pilot project. The whānau were interested in whether the tool could help facilitate and communicate to Crown and Council agencies, and how baseline processes and standards may be achieved to strengthen the Iwi- Crown Treaty partnership.

The key question was: Will this help us strengthen our active kaitiakitanga roles and responsibilities for Te Tai-o-Aorere?

At the request of one of the whānau, an exercise was undertaken to provide an overview of the iwi engagement and participation context with Crown, Council agencies, research or other 'systems' that Iwi needed to be aware of or actively engaged in. These various other systems were captured on the whiteboard. This was to:

   a. help contextualise the iwi context, the tensions and frustrations with siloed research projects and contemporary resource management settings, and

   b. to help situate this pilot project within the complexity of various other research projects; to understand the relevance and application; and to aid iwi in their proactive efforts with various Crown and Council agencies.

The results of this process are summarised in Appendix 4

Once this important process was completed, participants decided to continue to engage in this pilot causal loop mapping project.

6.2.3 The many interpretations of the word 'system', so it is avoided

During preparations for, and up until this point in the workshop, the facilitators were calling the methodology 'systems mapping' or 'systems thinking'. This is the common term that the approach is known by. It was also consistent with the terminology used in the first CP2.1 pilot (see Connolly, 2019) and its other applications in the Challenge.

Yet during the workshop discussions to date, it became apparent that the term 'system' had many interpretations. For some it described a process; for others it described the many different mechanisms that had been captured in the activity outlined in the previous sub-section. For others still, it inferred the entire (or multiple) pākehā social construct(s) that Māori were required to engage with, outside of te ao Māori. It was found to be a highly loaded and problematic term.

As this was likely to cause frustration and confusion, it was therefore agreed that the term 'system' would not be used when referring to this approach. **During the workshop (and in subsequent discussions) it was agreed to referred to it as** *causal loop mapping* **rather than** *system mapping*.

6.2.4 Changing the focus – from the decline in scallops (interchanged with kaimoana), to the ability for kaitiaki to care for Te Tai-o-Aorere ki Mohua and uphold manaakitanga

The final and very important insight from Workshop One, was that whānau could not silo focus on the decline of scallops without considering Te Tai-o-Aorere ki Mohua as a whole, and the historical and current barriers to kaitiakitanga.

Therefore, the focus of the subject changed from the decline in scallops/kaimoana to the decline in the level of ability for kaitiaki to care for (tiaki) Te Tai-o-Aorere ki Mohua and in turn, the decline in the level of ability for kaitiaki to uphold rangatiratanga, kaitiakitanga and manaakitanga. This approach highlighted the importance for kaitiaki to strengthen their roles and responsibilities to Te Tai-o-Aorere ki Mohua, to uphold tikanga related to sustainable management because there is an urgent need to have a plentiful source of kaimoana to support manaakitanga.

This was a seminal point and the entire nature of the discussions changed, and the whānau were much more comfortable articulating the variables that impacted on rangatiratanga, kaitiakitanga and manaakitanga. A photo of many of these variables collated on the wall is shown in Figure 4.

Figure 4.   Example variables that influence Manaaki(tanga), from Workshop One

Workshop one ended with the facilitator taking some of these variables and drawing the beginnings of a feedback loop on the whiteboard. This was to demonstrate the concept of feedback loops and causality-loops (e.g. feedback loop) that had been discussed at the beginning of the workshop.

Figure 5.   Draft feedback loop drawn from variables in first workshop, to demonstrate the concept

The whānau found this feedback loop approach interesting and were keen to see how te ao Māori values and perspectives might be able to be represented in a causal loop mapping tool.

It was agreed that the whānau would like to attend a second workshop, where the facilitator would present back some draft components of a causal loop map.

6.3 Workshop Two

In workshop two the whānau discussed the issues of significance for the decline of scallops/kaimoana including climate change events and its impact on marine environment, sediment effects and variable baseline processes and standards for Council and Crown agencies in the management of the coastal marine environment. However, given the work undertaken in the CP2.1 project there was consensus not to further explore anthropogenic and biological factors that whānau believe influence the decline of scallops/kaimoana within Te Tai-o-Aorere ki Mohua.

The whānau discussed tikanga and relevance for 21st century tikanga led land and water governance and management. Whānau also reiterated (from workshop one) the importance of caring for Te Tai-o-Aorere ki Mohua to support the harvest of sustainable levels of scallops/kaimoana. Customary take/allocation were prioritised over recreation and commercial take, and there was discussion about the important role of recreational fishing for Māori coastal communities. Recreation fishing was conceptualised as those who are not fishing to support Māori coastal communities with limited or no understanding of the tikanga in the rohe moana where they fish. This information helped the

facilitator start to understand tikanga and the importance of customary takes for whānau, hapū and Iwi.

A key outcome for the whānau is to restore and protect Te Tai-o-Aorere ki Mohua, scallops/kaimoana and mahinga kai areas to ensure intergenerational benefits for their mokopuna to be able to sustainably collect kaimoana from within their rohe.

One of the whānau participants also highlighted his Southern Scallop Working Group participation and Southern Scallop Strategy: Marlborough Sounds (Fisheries NZ). He remarked that the causal loop map would have been useful in that process. It was also useful to inform the whānau of other projects that are also seeking restorative outcomes for a sustainable scallop fishery.

6.3.1 Increased alignment on the potential of the tool

By the end of the second workshop there was alignment amongst the whānau that the causal loop mapping tool could be useful for a range of uses. It was seen as a way of helping to demonstrate many of the interconnected components of te ao Māori.

6.4 Post workshops – working session 1

The purpose of this working session was to review the updated causal loop map provided by Deliberate based on workshop two and to provide feedback. The authors placed caveats on the draft causal loop map as the work is in progress and not a representation for all Iwi in Te Tau ihu. The whānau participants whakapapa to various Te Tau Ihu Iwi, as such their mātauranga and lived experiences are placed based and unique to their specific rohe within Te Tai-o-Aorere ki Mohua.

There was unanimous whānau agreement to focus on a set of shared te ao Māori values and perspectives and reinforced that te ao Māori is holistic and interconnected with the natural world and tangata whenua and therefore land, water and moana management should be approached through a holistic framework - ki uta ki tai from the mountains to the sea.

The whānau acknowledge catchments as an integrated whole and the interconnected relationship between all living things. In order to safeguard the integrity of Te Tai-o-Aorere ki Mohua, coastal marine environments and scallops, the whānau consider it is critical that all activities within the catchments are managed in an integrated way.

Frustration was reiterated by the whānau due to having to participate in siloed, multiple-agency land and water management processes (i.e. reductionism), in contrast to te ao Māori (holism). It was noted that agencies work separate to each other, reinforcing the legislative and regulatory compartmentalisation of the natural world, that include: Councils, MPI, DOC, RMA, LGA, plans and policies. For example, the Fisheries Act recognised and formalised Iwi legal rights, however, the customary allocation framework under the Act is disconnected from ki uta ki tai - te ao Māori.

In addition, the whānau reported that historically research projects exclude te ao Māori tikanga, values and mātauranga as a valid knowledge source to address contemporary issues and outcomes for the natural world. See Appendix 4 for kaitiaki context of engagement and participation with various agencies to ensure te ao Māori values and perspectives are given effect to as guaranteed in Te Tiriti o Waitangi.

The whānau reaffirms Te Tiriti o Waitangi as the foundation for all partnership endeavours with Crown and Council agencies. Although the Treaty Settlements provide less than one percent redress for historical wrongs, the challenge for Iwi is to significantly improve their environmental, social, cultural and economic wellbeing in their rohe.

6.5 Finalising the system map – socialising with other Iwi

It is important to note that the whānau and facilitator have not socialised the pilot output of the causal loop map with other Iwi entities due to limited capacity and timeframes. In the future, there may be opportunities to share this pilot project at an Iwi forum.

6.6 Informal feedback from participants about the process

This section summarises the whānau feedback regarding their experience of the process and is based on anecdotal feedback and discussions.

The whānau had no prior knowledge about systems structure and causal loop mapping, therefore the first workshop was important to discuss the cultural context and research project context. It was also important for the whānau to understand how the tool may support their kaitiaki role and cross-cultural communication and decision making with Crown and Council processes to achieve positive restorative outcomes for Te Tai-o-Aorere ki Mohua.

Some of the comments from participants are quoted below:

> *"it was good to come together to share our knowledge and experience on fisheries management…we understand the issues… we want to collect kai…just not sure how this tool will help us" (Stephens, A. 2020)*

> *"this tool should help us communicate to Crown and Council agencies who have different baseline processes and environmental standards and inform them on how to get to iwi baselines" (Te Miha, F. 2020)*

> *"the worksheet process[9] excludes our relationship with ngā Atua and the natural world" (Stafford, K. 2020)*

> *"it was easy to talk to te ao Māori and Māori values but it was hard to apply the information within a theoretical western framework tool" (Stafford, K. 2020)*

> *"we're concerned about who would use the map, how this map would inform iwi advocacy with Crown and Council agencies (Te Miha, F, Stephens, A. 2020)*

---

[9] The 'worksheet process' refers to the temporal graphing exercise described later as 'analogue simulation'

7 Pilot causal map overview – a whānau perspective for Te Tai-o-Aorere ki Mohua

Summary:

- *Readers should take time to familiarise themselves with the basic loops of systems mapping – reinforcing and balancing loops –to get the best out of the causal loop map insights.*

- *Causal loop mapping is considered to have value in demonstrating the challenges for Māori in natural resource management space.*

The whānau that contributed to this pilot causal project are practitioners and have extensive mātauranga and experiences within the marine environment. They actively exercise kaitiakitanga and customary practices and engage with a range of Council and Crown Agencies on Treaty settlement and environmental management policy, plans and processes to protect their cultural values.

Whānau contributed their insights and cultural narratives to describe the associated loops and variables within the causal map. Whānau, hapū and iwi contribute a wealth and depth of mātauranga and have intergenerational sustainability objectives that assist and inform Crown and Council Agencies to meet their Te Tiriti obligations and responsibilities.

Figure 6.   Pilot causal loop map developed by the whānau
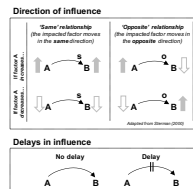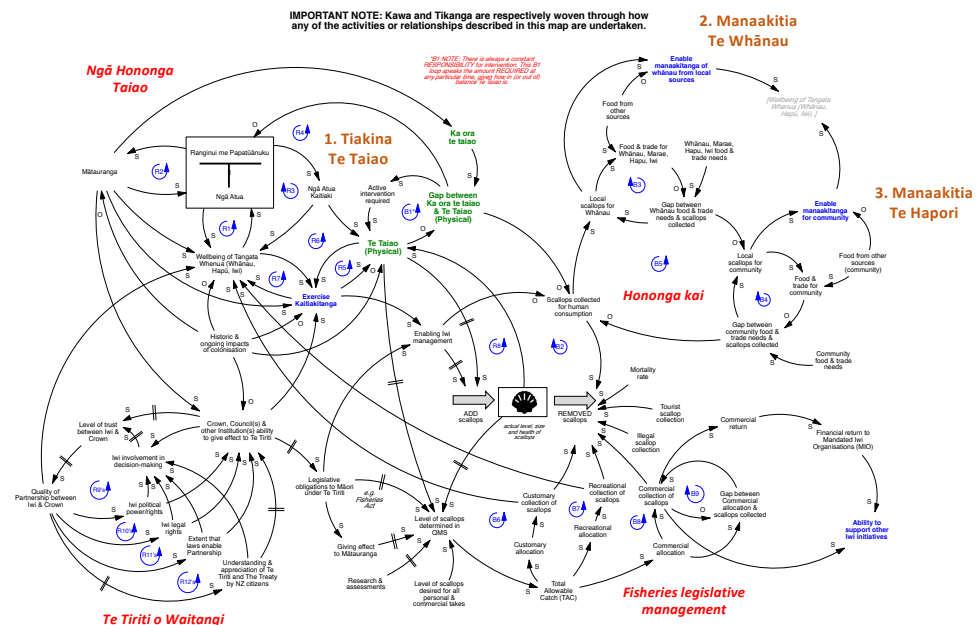
This section seeks to provide a summary of the key approach and terminology on the causal map, to aid understanding the range of loops and variables and relationships provided within pilot causal loop map. The map is shown at small scale in Figure 6, while a larger version is provided later in the report (section 7.5, Figure 20). An illustration of the labelling terminology and symbols also follows (Figure 7).

The causal map tool comes from an engineering background (see section 2). As it is a product of a non-Māori knowledge system, its ability to appropriately communicate the depth of te ao Māori is uncertain.

Several iterations of the causal map were drafted to check the collective interpretation and understanding of te reo Māori, English and causal mapping terminology. This process was extensive and iterative as cross-cultural language and context, application, translation and interpretations of information had to be clarified and confirmed several times. However, despite these challenges, the whānau continued to pilot the tool as a potential mechanism to help communicate their values and perspectives in a way that retains its integrity and provide insight to a wider audience.

Here we summarise the approach taken to create the Te Tai-o-Aorere ki Mohua pilot scallop/kaimoana causal map, the associated terminology and symbols are briefly described.

7.1 Map approach, terminology, and symbols

The labelling of causal relationships is illustrated in the overall map and is represented by an arrow between variables/components on the map. The arrow indicates the direction of causal influence and the label *same* or *opposite* the type of change in the variable the influence will have. Relative delays are indicated with a short double line across the arrow. Examples of both of these are shown in Figure 7.

Figure 7.   Labelling of causal relationships and delays
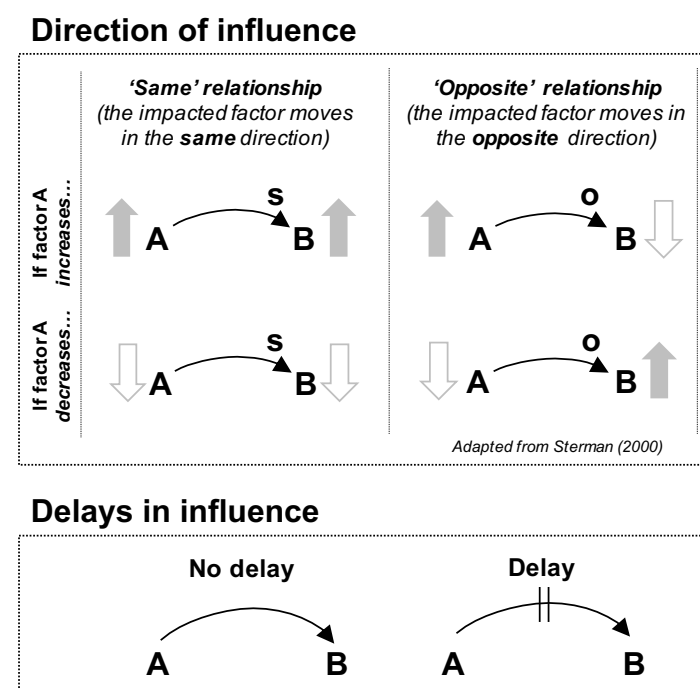
Where a loop has been identified within the map, it has been labelled with a letter and a number (e.g., **R1, R2, R3**…etc; and **B1, B2, B3**…etc). This is to help differentiate the loops from each other and aid with identification. It is in no way intended to suggest any prioritisation, primacy or order of importance of loops. Where numbered loops are referenced in the narrative text this has also been bolded e.g., **(R1)**.

There are two types of feedback loops – reinforcing loops e.g., **(R1)** and balancing loops e.g., **(B1)**. Reinforcing loops are made up of influences that continue to reinforce the original change or influence, resulting in a behaviour of self-reinforcing increases or declines. Balancing loops are made

up of influences that cancel out the original change or influence, resulting in static or oscillating behaviour.

Figure 8.   The two types of feedback loops
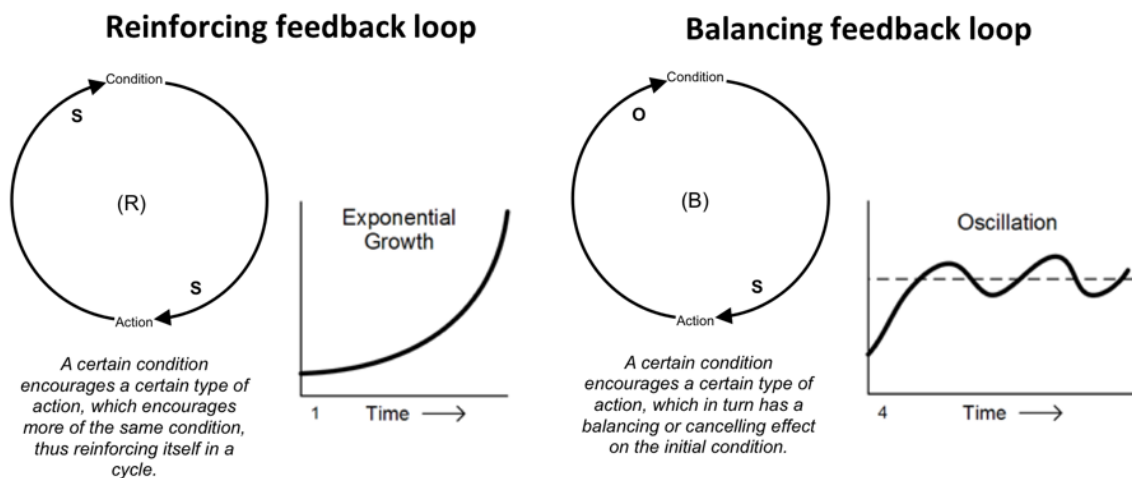
Adapted from Senge (1990) & Ford (2010)

It is recommended that readers are familiar with these loops before reading the description of the map. For a detailed description of balancing and reinforcing loops, refer to Appendix 1: The fundamentals of causal loop mapping (systems thinking).

When variables from the map are used in the description or narrative, they have been italicised and bolded e.g., '***mātauranga***' or '***historic & ongoing impacts of colonisation'***.

The methodological approach of this tool requires components (e.g., mātauranga) to be identified in such a way that any change in them could be described as an *increase* or *decrease*. At times, this caused discomfort with the whānau as it required them to 'translate' and compartmentalise te ao Māori and their interrelationships into 'components'.

For instance, using these two components (***mātauranga*** and the '***wellbeing of Tangata Whenua***'), the former component is known as the influencer and the latter component the influenced component.

The arrow from '***mātauranga'*** to ***wellbeing of Tangata Whenua*** has the letter 'S' on it (Figure 9), which means that the influence moves in the 'same direction' – that is, the *influenced* component moves in the *same direction as the influencer* (see Figure 7). This means if ***mātauranga*** increases then ***wellbeing of Tangata Whenua*** also increases, and vice versa.

Figure 9.   Actively labelled components and a same causal arrow between them
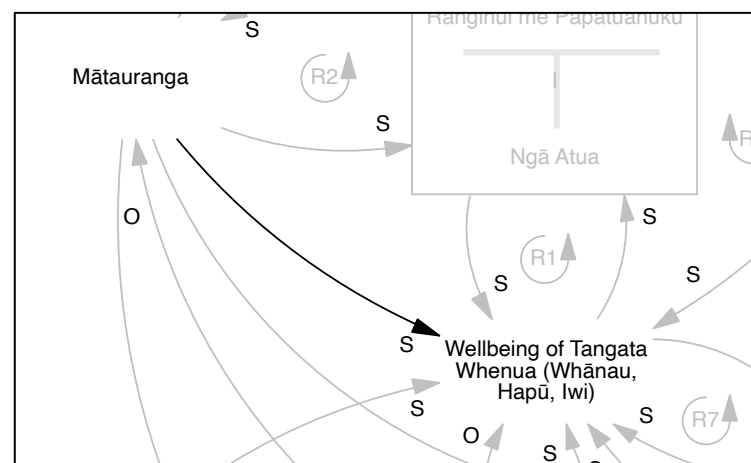
Conversely, if a relationship has an 'O' label, this means the influence moves in the 'opposite direction' – that is, *influenced* component moves in the *opposite direction as the influencer*. For example, the influencing component labelled '**historic & ongoing impacts of colonisation**' has the 'opposite relationship' with the above components, ***mātauranga*** and the ***wellbeing of Tangata***

Whenua, which means if the component ***historic & ongoing impacts of colonisation*** increases then both ***mātauranga*** and the ***wellbeing of Tangata Whenua*** decreases, and vice versa (see 0).

As illustrated, these symbols support understanding of whether an influenced component moves in the same or opposite direction to the influencer. This leads to the core understanding of whether, over time, the components in the map may be moving in the desired direction i.e., increasing or declining.

Figure 10.   Actively labelled components and an opposite causal arrow between them
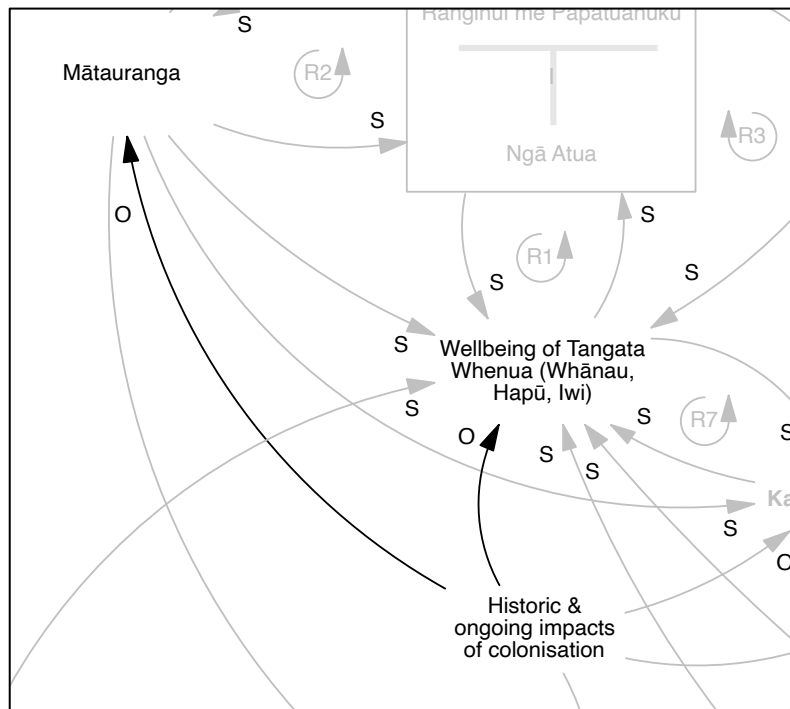
For example, it was important to understand the key components that influence the scallop fishery according to whānau, and how these are interconnected with exercising customary practices such as caring for ngā taiao, which is reciprocal to the wellbeing of people, their practices of manaakitanga te whānau and the wider community - manaakitia te hapori. Further details of how the causal loop mapping tool works is provided in Appendix 1.

7.2 Key areas of the causal loop map

Summary:

- *Four main areas of the causal loop map were developed:*
    - *Ngā Hononga Taiao – Whakapapa, Ranginui me Papatūānuku, ngā atua, Te Taiao and Tangata Whenua.*
    - *Hononga Kai – the provision of kaimoana as a fundamental customary value, right and practice.*
    - *Te Tiriti o Waitangi – the importance of tino rangatiratanga, and the kawanatanga relationship between Te Tiriti o Waitangi partners.*
    - *Fisheries Management Legislation – mechanisms of fisheries management and the obligations to Māori under Te Tiriti o Waitangi*

This pilot project is an attempt to visualise the decline in scallop/kaimoana 'issue' from a whānau perspective.

Whakapapa is at the heart of the causal loop map. Whakapapa is the genealogical lineage and connection to 'Ranginui me Papatūānuku', their many children – 'Ngā Atua', and the divine processes that physically manifest in te Taiao (the natural world) including all living and non-living resources. It is through whakapapa to Ngā Atua, (including Tangaroa - atua of the sea, rivers, lakes and creatures

that live within them) that Tāngata Whenua (the whānau within this project) inherit their birth right and duty as kaitiaki of their respective rohe that includes Te Tai-o-Aorere ki Mohua. Therefore, degradation of one species or resource is understood in terms of the negative impacts to the whole living system and to people themselves.

The four key areas that whānau developed within the map are indicated with *red labels* (see Figure 6):

1. **Ngā Hononga Taiao (red title):** Whakapapa and obligations to uphold and nurture the interconnected spiritual and physical relationships of Ranginui me Papatuānuku, Ngā Atua, te Taiao (the natural world) and Tāngata Whenua.

   Mātauranga encapsulates te ao Māori, and interrelationships support te Taiao and Tāngata Whenua wellbeing, necessitating the exercise of kaitiakitanga as an expression and demonstration of tino rangatiratanga. This is a reciprocal relationship as tino rangatiratanga and Mana Whenua and Mana Moana provides the authority for kaitiakitanga to be exercised.

2. **Hononga kai (red title):** The loops in this area focus on the provision of scallops/ kaimoana, a fundamental tāngata whenua value, right and practice. It highlights the priority aspirations for whānau, marae, hapū and iwi which is to uphold the mauri of Te Tai-o-Aorere ki Mohua. It recognises the rights of tāngata whenua to exercise kaitiakitanga, manaakitanga and decision making to maintain a healthy and sustainable supply of scallops/kaimoana.

   Although the 'issue' matter for the causal loop map was the decline of scallops, whānau highlighted that all kaimoana within Te Tai-o-Aorere ki Mohua are at risk and declining, and therefore the scallops represented within this map could be interchanged to represent the same impacts other kaimoana are facing and how we could best improve their sustainability.

3. **Te Tiriti o Waiangi (red title):** The foundation for this area is Te Tiriti o Waitangi (the te Reo Māori version), including components that refer to The Treaty (the English version), as the Crown and Councils operate within the principles of the Treaty. The whānau assert that Te Tiriti o Waitangi guarantees tino rangatiratanga (full self-governance, full self-management, and full self-determination) and establishes an enduring partnership between Māori and the Crown.

   In contemporary environmental management, this partnership necessitates shared responsibility for co-governing and co-managing te Taiao – the Crown fulfilling statutory obligations and Māori exercising kaitiakitanga. The whānau also affirm tino rangatiratanga is essential for the full practice of kaitiakitanga, as self-determination and authority are interdependent.

   This interconnected area of loops ultimately influence the wellbeing of te Taiao, Tāngata Whenua and wider communities. However, barriers such as the intergenerational and ongoing impacts of colonisation and institutional racism hinder kaitiakitanga and tino rangatiratanga. Protecting the mauri of te Taiao requires co-governance and co-management within Te Tiriti frameworks, demanding urgent and decisive action.

4. **Fisheries legislative management (red title):** This area is connected to the Te Tiriti o Waitangi loops, representing the settlement of fisheries claims through key legislative instruments i.e., the 1992 Deed of Settlement that is implemented through the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992, the Fisheries Act 1996 and the Māori Fisheries Act 2004.

   The loops depict Māori rights and interests in fisheries while also highlighting the legislative levers or barriers impacting whānau, hapū and iwi. For example, the need for mātauranga Māori to inform fisheries management; commercial fishing allocation limits through the Quota Management System are negatively perceived by whānau due to their experience and the state of fisheries. Further barriers include processes that continue to minimise whānau and hapū participation in local fisheries governance and management.

The whānau also discussed the artificial separation between customary and commercial fishing and prioritise customary take/allocation over recreation and commercial take within the causal loop map. They recognise the important role of recreational fishing for Māori coastal communities, contrasting it with the activities of those who fish without understanding or respecting the kawa and tikanga in the rohe moana.

Ultimately, the effective management of fisheries under Te Tiriti necessitates legislative frameworks and management practices that genuinely uphold kaitiakitanga.

7.3 Customary practices inherent within the pilot causal loop map

Summary:

- *Customary practices and behaviours are inherent and woven throughout the causal loop map.*

The whānau discussed customary practices and behaviours inherent within the pilot causal loop map and offered the following *orange labels* (see Figure 6):

1. *Tiakina te Taiao (orange title)* – respect and nurture te Taiao in accordance with kawa and tikanga customary practices. To actively protect and enhance the mauri of te Taiao (therefore Te Tai-o-Aorere) so to provide for a healthy sustainable supply of kaimoana/scallops in order to provide kai and uplift manaakitanga, The natural environment provides cultural, social and economic wellbeing for whānau, hapū, iwi;

2. *Manaakitia te whānau (orange title)* – manaakitanga and acts of caring for and giving scallops/kaimoana to support the wellbeing of other whānau, hapū, iwi, manuhiri

3. *Manaakitia te hapori (orange title)* – manaakitanga and acts of caring for and giving scallops/kaimoana to support and care for the wellbeing of the wider community.

Here, we highlight '*Tiakina te taiao'* (in orange Figure 6), within the 'Ngā Hononga Taiao' area of the causal loop map to reflect the interconnected relationships of Ngā Atua, te Taiao and Tāngata Whenua.

For example, during COVID-19 level 4, iwi had access to pātaka kai (storage of wet fish) and were able to distribute kaimoana to whānau and communities around the country. This is manaakitanga in action.

7.4 Description of the causal loop map

Summary:

- **The causal loop map is described in the following way:**
  - **Te mauri o Te Taiao - spiritual and physical**
  - **Ngā Hononga Taiao**
  - **Tiakina te taiao**
  - **Enabling Iwi Management and decision making**
  - **Historic & ongoing impacts of colonisation**
  - **Hononga Kai, manaakitia te whānau and manaakitia te hapori**
  - **Fisheries Legislative Management loops**
  - **Te Tiriti o Waitangi loops**
  - **How the Te Tiriti o Waitangi loop links to the rest of the map**

The causal loop map is described here across nine sub-sections. The key areas, Māori values and customary practices described above may appear together or separate in these descriptions.

7.4.1 Te mauri o Te Taiao - spiritual and physical

Summary:

- **Kaitiakitanga is the duty arising from whakapapa to nurture and care for te Taiao (natural world) physical well-being and mauri**

- **Kaimoana and all living things are taonga tuku iho.**

- **The protection and enhancement of the mauri of te taiao so to provide for is central to Māori values.**

Kaitiakitanga is the duty arising from whakapapa to nurture and care for te Taiao (natural world) physical well-being and mauri. Whānau have the responsibility to carry out kaitiakitanga practices to manage and support the life force, mana and health of te Taiao/Te Tai-o-Aorere ki Mohua.

The causal loop map refers to scallops (as a general representative of kaimoana). The scallop population is represented by the boxed scallop shell image with the label *actual level, size and health of scallops* (Figure 1 below). This label represents the population metrics of current population numbers (actual level), size structure and health.

The wide arrow pointing into the box represents **ADD scallops**, that is additional scallops into the population through spawning, recruitment, and the maturing process. The wide arrow pointing out of the box represents all **REMOVED scallops**, through processes such as natural mortality, disease, predation, and harvesting by people.

The map illustrates whānau experience, that the better the health of the natural world (***Te Taiao/Te Tai-o-Aorere ki Mohua (Physical)***), the greater the likelihood of **additional scallops** entering the scallop population. With additional **scallops**, there is an increase in **actual level, size and health of scallops**, which reflects the health of the natural world (***Te Taiao (Physical)***). This relationship is symbolised by a reinforcing loop (**R8**) to show that the health of any one of these components

SUSTAINABLE SEAS
43
Piloting the use of Systems Mapping in the Sustainable Seas National Science Challenge
Causal Loop Mapping Pilot – a whānau perspective for Te Tai Aorere ki Mohua

influences the health of the other components (i.e., if they are in good health, then this loop reinforces in a positive direction. If they are in bad health, then this loop reinforces in a negative direction).

Figure 11.   Scallops and the health of Te Taiao
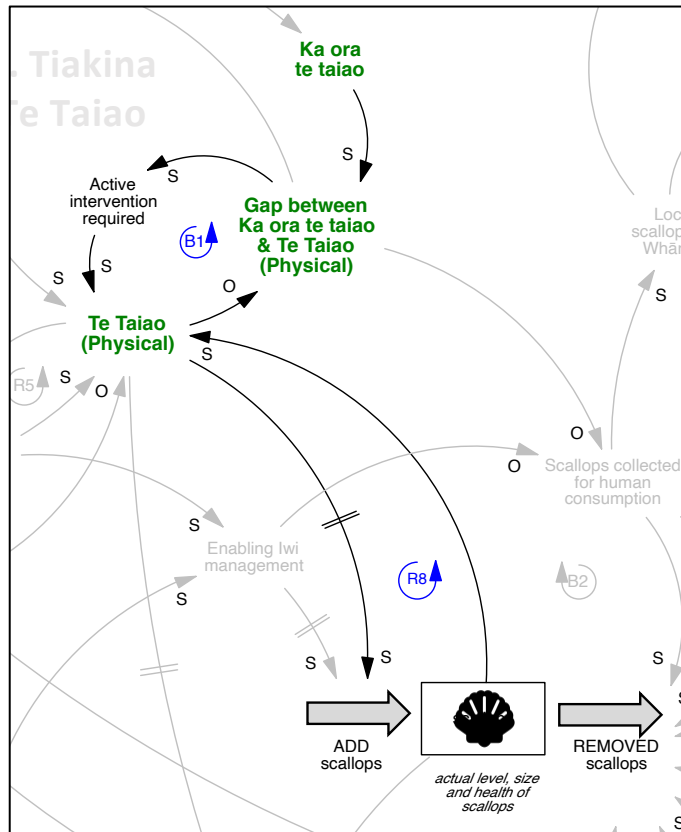
There are three components (shown in **green**) that reflect the links between the health levels of te Taiao with kaitiakitanga - the duty and responsibility to protect and enhance to mauri of kaimoana.

The node *Ka ora te taiao* refers to the *__aspirational__* health/mauri of te taiao. The node *Te Taiao (Physical)* refers to the *__current__* health/mauri of te Taiao (of which scallops are but one element). The third node, *Difference between Ka ora te taiao and Te Taiao (Physical)*, represents how in or out of balance these two components are. If they are out of balance, the difference is large, and a greater level of action is required to improve the health/mauri of *Te Taiao (Physical)*, thus contributing to improving and enhancing the muri of the natural environment.

If the health/mauri of te Taiao is vibrant, the smaller the gap between the aspirational levels of physical and spiritual wellbeing and the current state of the physical and spiritual wellbeing. Therefore, the less active intervention is required.

Currently, whānau experience Te Tai-o-Aorere me Mohua in poor, degraded health/low level of vibrancy/mauri which in turn means that te Taiao is of low vibrancy/mauri. A key action for whānau is to improve the baseline health of Te Tai-o-Aorere me Mohua and te Taiao which, in turn, will reduce the gap between the current health status (*Te Taiao (Physical)*) and the aspirational level of health (*Ka ora te taiao*).

Consequently, the gap represented by how the three components (in **green** in Figure 1) interact, is of critical importance in this causal loop map. The aspiration of whānau is to reduce the gap via ki uta ki tai co-governance/co-management, holistic and net positive restorative outcomes, promoting actions and interventions to protect Māori values.

7.4.2 Ngā Hononga Taiao

Summary:

- *The health and wellbeing of Ranginui me Papatūāhuku, Ngā Atua, Ngā Atua Kaitiaki, Tāngata Whenua are interconnected.*

- *A change in the health and wellbeing of one will result in a similar change in the health and wellbeing of the others.*

The interconnected set of components in the Ngā Hononga Taiao section of the map attempts to depict te ao Māori interrelationships.

Figure 12.   Ngā Hononga Taiao
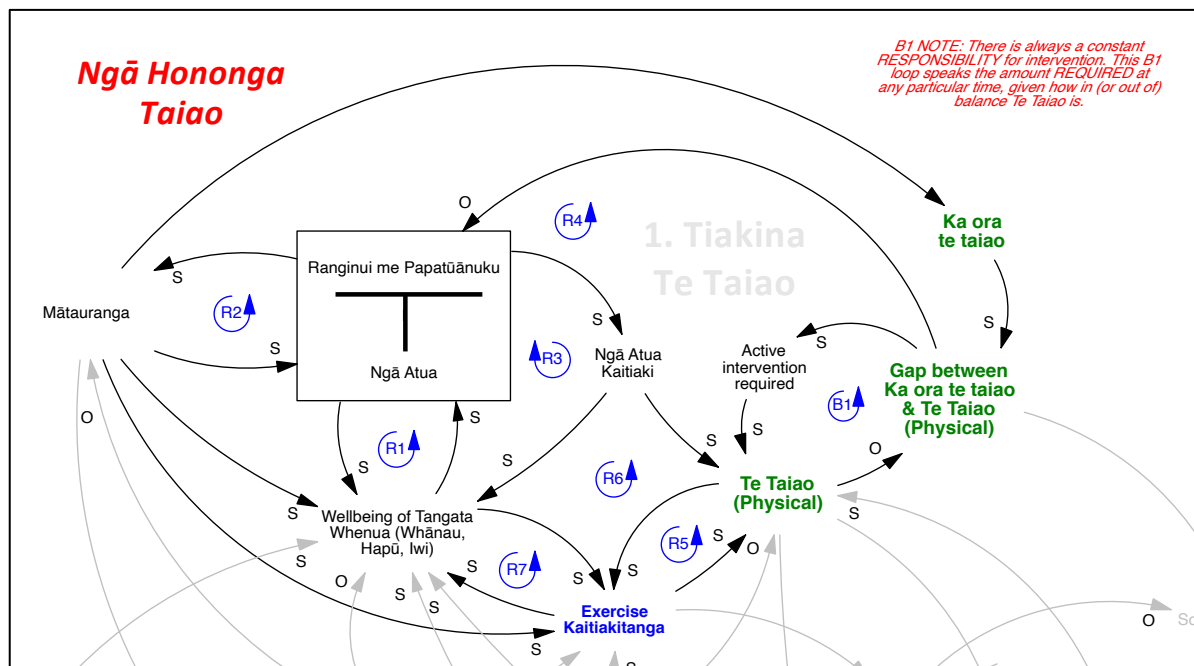
Whakapapa is the genealogical lineage and connection to ***Ranginui me Papatūānuku*** their many children - **Ngā Atua**, **Ngā Atua Kaitiaki**, the ***Wellbeing of Tangata Whenua*** and ***Mātauranga***

If ***Ranginui and Papatūānuku*** are healthy as reflected in the physical domains of the natural world, then the ***Wellbeing of Tāngata Whenua (Whānau, Hapū, Iwi)*** is also good. Further, the health and wellbeing of Ngā Atua and Tāngata Whenua will trend in a positive direction **(R1)**. At the same time, if ***Ranginui and Papatūānuku*** are healthy, it also reinforces the quality of ***Mātauranga*** and its ability to support action, which in turn further reinforces the spiritual health and physical domains of ***Ranginui and Papatūānuku*** **(R2)**. This also has positive flow on impacts to the ***Wellbeing of Tangata Whenua***.

Similarly, if the health of the spiritual and physical domains of ***Ranginui and Papatūānuku*** increases, so too does this reinforce and increase the vitality and value of ***Ngā Atua Kaitiaki***, which further influences ***Wellbeing of Tāngata Whenua***, and ***Ranginui and Papatūānuku*** **(R3)**.

R4 demonstrates how ***Ranginui and Papatūānuku***, ***Ngā Atua Kaitiaki*** and ***Te Taiao (Physical)*** are interconnected. When ***Ranginui and Papatūānuku*** are healthy, as reflected in a healthy physical environment *(**Te Taiao (Physical)** and a low gap between aspirational and current health)*, then ***Ngā Atua Kaitiaki*** are also likely to be healthy. This is important as both a direct supporter of environmental health ***(Te Taiao (Physical)***.

Healthy **Ngā Atua Kaitiaki** are important monitors to moderate and monitor Tāngata Whenua behaviour around **Te Taiao (Physical)**, which acts to support the mauri and health of **Te Taiao (Physical)**. This reduces the gap between current state health and intended health (**Ka ora te taiao**), (taking into account the holistic and inter-dependence of each element of the natural world, kawa and tikanga) which further strengthens the spiritual and physical elements of **Ranginui and Papatūānuku and Ngā Atua**.

A similar loop here is **R6**. The intention of this loop is to demonstrate how **Ranginui and Papatūānuku**, **ngā atua Kaitiaki** and **Te Taiao (Physical)** are interconnected and also includes the impact on the **Wellbeing of Tāngata Whenua** and the exercise of kaitiakitanga.

The narrative here is the quality of the health and **Wellbeing of Tāngata Whenua** to source local scallops/kaimoana reflects the ability for tangata whenua to **exercise kaitiakitanga**, to protect and enhance the mauri of **Te Taiao (Physical)**. Therefore, the closer it is to the intended levels of **Ka ora te taiao**, represented in the map by a low **gap between Ka ora te taiao (intended state) and Te Taiao (physical) (current state)**. When the gap is low, then the better **Ranginui and Papatūānuku** and subsequently (completing the loop) the better the **ngā atua kaitiaki** (spiritual and physical).

All these components are <u>reinforcing loops</u> (labelled with an 'R'). This means that whichever direction one trends, the others will too. That is, if the health of one were to improve then this would have a positive flow on affect to all the others.

However if one or all are out of balance and in poor health, they all negatively reinforce on each other, meaning all elements are impacted by an action, human or natural, and will reduce their mauri and vitality, or decline in stock to levels that may lead to negative outcomes and consequences. For example, if scallops/kaimoana are overharvested or the mature breeding taonga species are removed from the ecosystem then there is likely to be an associated consequence on the food chain and the spiritual health of Ngā Atua.

While the components and loops visualise causal impacts, these reflect 'relationships' and 'values' that are interconnected and influence the behaviour of Tāngata Whenua. For example, the greater the health of the relationship between **Ranginui and Papatūānuku**, (spiritual and physical), the greater the ability and wellbeing of Tangata Kaitiaki (through Mātauranga, tikanga/customary practices).

Whakapapa encapsulates the narrative for the **Wellbeing of Tāngata Whenua** and the **Mātauranga** components. For example, **kaitiakitanga** can be exercised to its fullest extent by Tāngata Whenua when there is willingness for the Crown, Council and others to embrace te ao Māori and enact co-governance and co-management processes. This will reinforce and reaffirm the positive value and application of mātauranga and Māori values in natural environmental management. This leads to cumulative positive beneficial environmental, social, cultural and economic outcomes for te taiao, the wellbeing of Tangata Whenua **(R7)** and other communities.

Similarly, the better an individual or communities understand te ao Māori, the more likely, Māori values are protected, the mauri of **Te Taiao (Physical)** is reinvigorated and kaitiakitanga practices and initiatives are actively promoted, supported and implemented.

The ability of whānau to provide scallops/kaimoana for whānau, marae, hapū and Iwi (discussed in section 7.4.6) is associated to the ability of whānau to tiaki te taiao (in all areas of institutional decision making) and maintain healthy sustainable levels of scallops/kaimoana. If the state of fisheries are poor and the ability of whānau to tiaki te taiao is limited and restricted by regulatory decision makers, then scallops/kaimona suffer with poor health and low levels available for harvest for kai. There will also be a consequential impact on health and wellbeing and relationships with Ranginui and Papatūānuku, ngā atua kaitiaki and Tangata Whenua.

If the level of whānau **Mātauranga** is high, this strengthens whānau **exercise of kaitiakitanga** (in association with whānau, hapū and Iwi participating in co-governance and co-management regulatory decision making processes). The revitalisation of **tikanga and kawa, te reo Māori, Mātauranga**

guides how whānau interact with te Taiao and will strengthen their interrelationships and actions of kaitiakitanga.

7.4.3 Tiakina te taiao

Summary:

- *The obligation, duty and responsibility of whānau to tiaki (care for) te taiao is constant and never diminishes.*

- *The actions required to care for te taiao at any one time will depend on how in or out of balance the health and mauri of te taiao is.*

The obligation, duty and responsibility of whānau to tiaki (care for) te taiao is constant and never diminishes. However, the actions required to care for te taiao is guided by how in or out of balance the health and mauri of te taiao is. This delicate balance is represented by loop **B1**. This loop therefore highlights the amount of active support or intervention required by whānau, hapū and Iwi to address their spiritual and physical interrelationships with te Taiao.

Figure 13.   Tiakina te Taiao
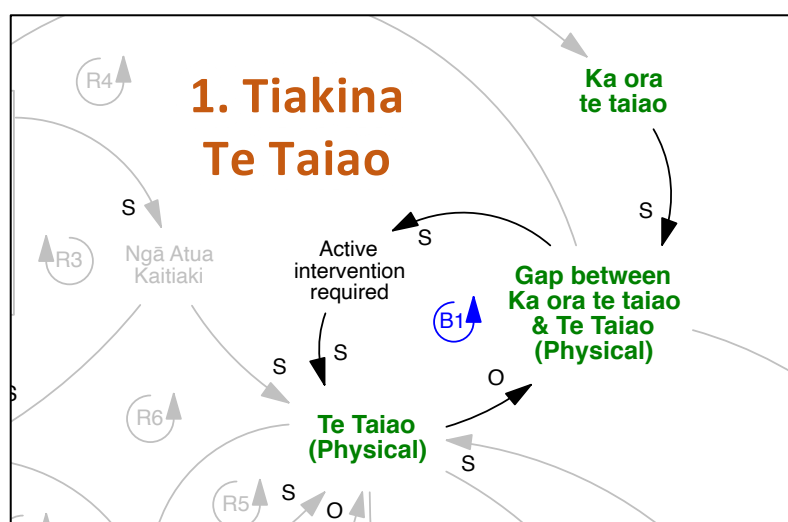
For example, when the ability of whānau to tiaki te taiao is limited (by external and internal factors) then the wellbeing of the mauri of *Te Taiao (Physical)* will also be limited.

If the current levels of mauri of *Te Taiao (Physical)* is low, then there is a large gap between the current state condition of poor health of *Te Taiao (Physical)* and whānau aspirations/requirements to reinvigorate, protect and enhance the mauri of te taiao (*Ka ora te taiao*).

This situation would contribute to the increase in the *Gap between Ka ora te taiao and Te Taiao (Physical)* – how 'out of balance' it is – therefore increasing the urgency and need for whānau to tiaki te taiao in order to protect, support, nurture, reinvigorate the mauri of *Te Taiao (Physical)*. This would bring things 'back into balance', hence this is represented as a *balancing loop* (**B1**).

As a whānau member noted in the He Pou Tokomanawa – Kaitiakitanga in Practice report (2019), the aspiration for the moana and community is:

> "The dream is to have a healthy, plentiful ocean that everyone can enjoy – that it's not exploited."

Below is another whānau narrative and aspiration from the same report and highlighted the importance of ngā atua kaitiaki, spiritual guardians and the relationship to the moana.

> Strengthening Mana Moana

> "…standing up for what you believe in – and we're starting to do that. Also, passing down to the next generation the importance of what the moana means and has meant to previous generations." Similarly, another interviewee reinforced the benefits of talking to and teaching our children that:

"Tangaroa … is our ancestor, and that they need to understand the power of that – how to manage that. […] It actually is a real superpower that we all have by virtue of our whakapapa and our genes where we can call on the incredible power of our taiao. So, the more that we exercise that muscle, the more powerful and awake we're going to be. And I really believe we're in a process of decolonisation, and obviously we've got some way to go, but being able to access those sorts of things will accelerate the process, I believe."

7.4.4 Enabling Iwi management and decision making

Summary:

- *The enabling iwi management node refers to the ability of whānau to implement tikanga such as rāhui, to manage an area or species regardless of contemporary regulations and legislation.*

The enabling iwi management node refers to the ability of whānau to implement tikanga such as a rāhui, to manage an area or species regardless of contemporary regulations and legislation. A rāhui is a temporary restriction on access to an area and mahinga kai, to protect and enable taonga species to regenerate. In the Ngāti Tama 'He Pou Tokomanawa Kaitiakitanga in Practice' Report (2019), the implementation of a rāhui was discussed by whānau as an important and effective tool for whānau and the regeneration of taonga species.

"We use our tools, rāhui. And rāhui has been for the whānau, hapū or iwi but [also] for all." (pg 21).

The arrows leading to and from the **enabling iwi management** node reflects the ability of whānau to apply rāhui (or other tikanga or method of traditional management) to areas to aid replenishment, protection and enhancement of scallop/kaimoana stocks. This links to the ability for te taiao to regenerate scallops/kaimoana, improve *Te Taiao (Physical)*, and is also enhanced when whānau are able to fully **exercise kaitiakitanga**.

Figure 14.   **Enabling Iwi management – improving te taiao and the exercise of kaitiakitanga**
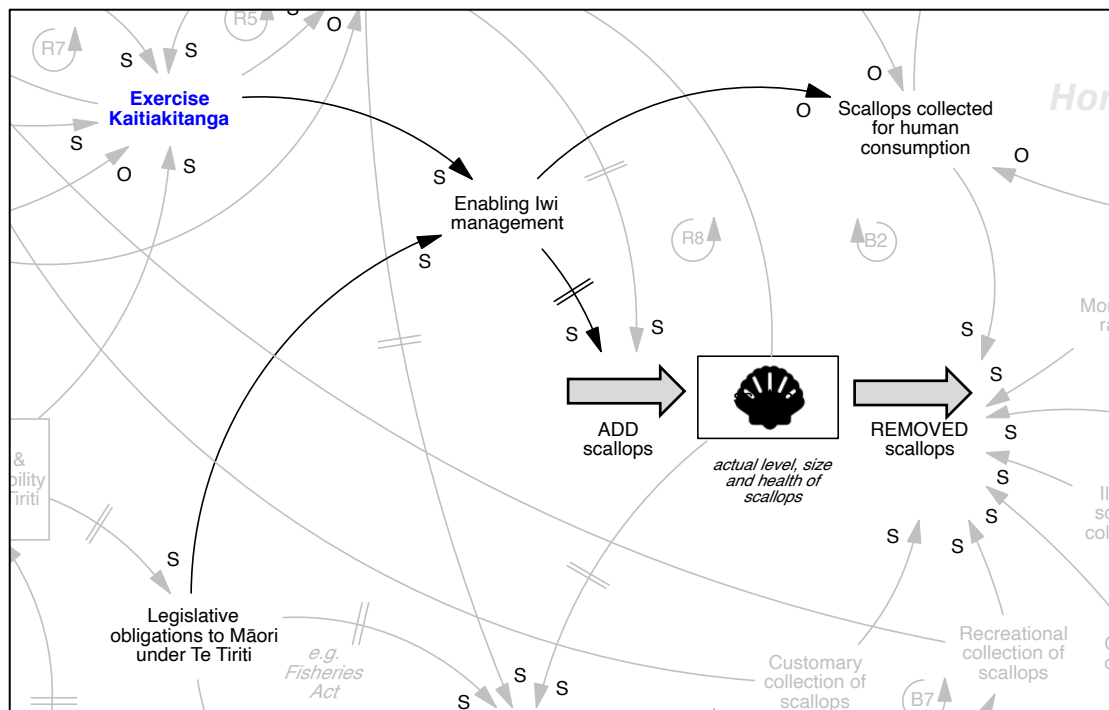
7.4.5 Historic & ongoing impacts of colonisation

Summary:

- *Missionaries and Crown policies to remove Māori identity, language, land and culture and to assimilate Māori to western value systems and religions are examples of the historic impacts of colonisation.*

- *The impacts of colonisation are not only a historic artefact, they persist into the modern day. The loss of land and access to and management of the natural environment, te reo Māori, culture and spirituality continues to impact on Māori.*

The *historic and ongoing impacts of colonisation* are associated to missionaries and Crown policies to remove Māori identity, language, land and culture and to assimilate Māori to western value systems and religions. The resulting outcomes of such actions and policies have driven/drive the development of urban areas and farmland, increasing direct and indirect pressures on kaimoana and their ecosystems, impacting mahinga kai practices. Crown and council policies have severely impacted the cultural context and associated practices of Mana Whenua and Mana Moana in relation to Te Tai-o-Aorere ki Mohua. This limits whānau, hapū and Iwi authority (including management), as well as their access to the coastal marine environment.

As affirmed in earlier sections of this report, Māori have a holistic, interconnected and dynamic relationship with the natural world based on spiritual and physical obligations and responsibilities to protect and enhance the mauri of all living things. However, in contrast, this node refers to European settlement in Aotearoa New Zealand and the dominance of Western thinking that segmented the natural world to discrete individual parts in order to seek knowledge of its various component parts. Humanity is understood as separate from the natural world and hierarchical with humanity in a dominant position. The different world views and the impacts of colonisation continue to be felt today through entrenched structural racism and inequitable social, cultural, environmental and economic outcomes for Māori.

The whānau participants identified the *Historic & ongoing impacts of colonisation* as a key node because the impacts of colonisation have had, and continue to have, profound negative consequences on Māori. Colonisation has a causal impact across the map, as it represents to Māori loss of tino rangatiratanga, which paved the way for spiritual, social, political, economic, and psychological domination. The loss of land and access to and management of the natural environment, te reo Māori, culture and spirituality continues to impact on Māori and their values.

The Mātauranga node is impacted by colonisation, for instance due to the exclusion of Māori in decision making processes, management practices and planning frameworks.

The *Wellbeing of Tangata Whenua* is also impacted by colonisation due to the cumulative impact of colonial policies and actions that have detrimentally impacted negatively on the health and wellbeing of Tangata Whenua. Colonisations ongoing impacts also continue to constrain Tangata Whenua's ability to *Exercise Kaitiakitanga*.

As a result, the cumulative impact is also on the physical world (*Te Taiao (Physical)*) because of the degradation, pollution, extinction of species, exploitation of natural environment, thereby significantly reducing the health and wellbeing of te taiao.

In addition, the impacts of colonisation continue to hamper the **Crown, Council(s) and other institution(s) to give effect to Te Tiriti**.

Figure 15. **Historic & ongoing impacts of colonisation**
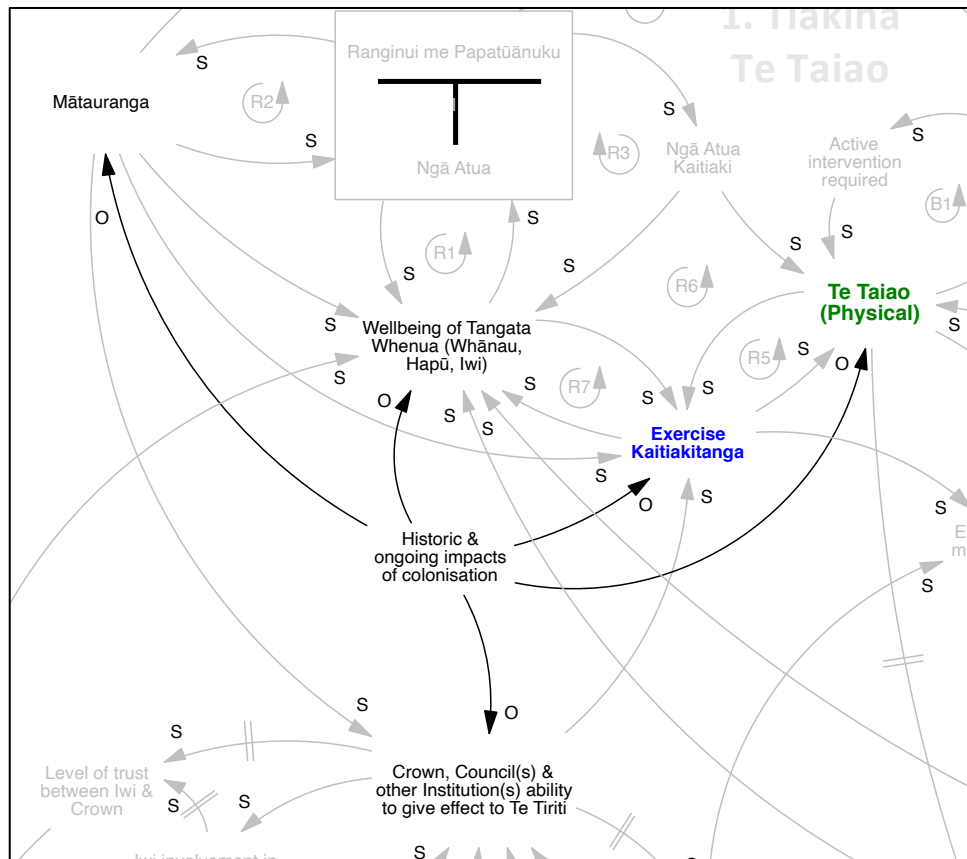
7.4.6 Hononga Kai, manaakitia te whānau and manaakitia te hapori

Summary:

- *Hononga Kai is a primary aspiration for whānau, marae, hapū and iwi, to protect, enhance, access and harvest scallops and other kaimoana for nourishment, wellbeing, and manaakitanga.*

- *For the whānau, manaakitia te whānau or the provision of food for whānau, marae, hapū and iwi is the first priority for human use. Manaakitia te hapori or the provision of food for the wider community is the second priority for human use.*

The *manaakitia te whānau* and *manaakitia te hapori* loops refer to whānau cultural values of manaakitanga and to provide kaimoana to whānau and then to the wider communities. These loops show the causal impact when scallops are collected for human consumption and refer to the importance for whānau to be able to manaaki whānau, marae, hapū and communities from sustainable levels of healthy scallops, preferably close to areas where they reside or from the wider iwi rohe.

The current level of scallops available for human consumption is based on the size and health of scallops and informs what is available for harvest and use. If they are healthy, then **Te Taiao** (including all the interrelated components of the ecosystems supporting scallops) is healthy/in balance, and may mean that scallops are available for collection, and the actual amount collected is represented by *Scallops collected for human consumption*.

SUSTAINABLE SEAS

50

Piloting the use of Systems Mapping in the Sustainable Seas National Science Challenge
Causal Loop Mapping Pilot – a whānau perspective for Te Tai Aorere ki Mohua

Figure 16.   Manaakitia te whānau and te hapori Hononga Kai loops
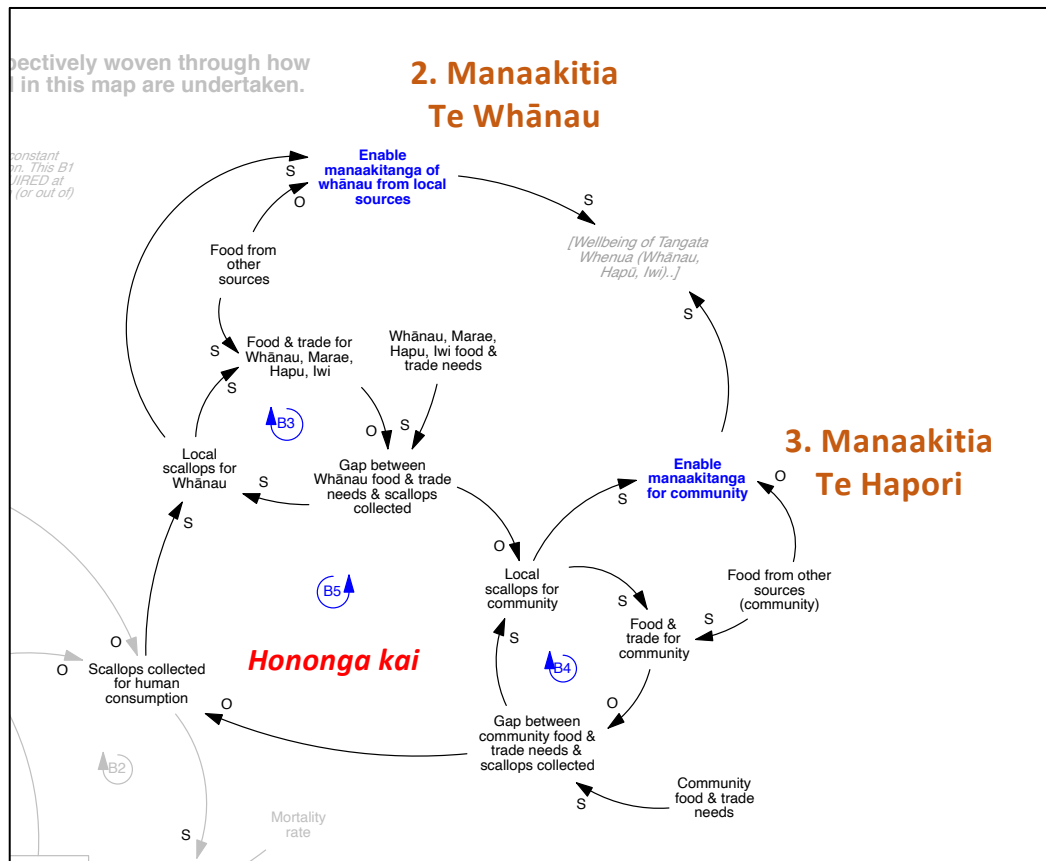
Whānau noted that they only harvest scallops/kaimoana based on what they can eat and share with their whānau and not because there is excessive supply of healthy scallops. However, if there is a tangihanga at the marae, then the harvest of kaimoana will be in accordance to provide for manuhiri consumption and therefore more kaimoana will be collected because of the potential number of manuhiri. The same approach is taken if there is a hui or event on in the whānau community.

This node is the start of the Hononga Kai loops.

Manaakitia te whānau is prioritised first, which is the provision of kaimoana (***Local scallops for whānau***) for ***food and trade for whānau, marae, hapū and Iwi***. A gap structure exists here between <u>food needs</u> and <u>actual food collected/provided</u>. When this need is met, this first loop comes into balance (**B3**).

If there is insufficient scallops available, the need for scallops/kaimoana will be met with ***Food from other sources***. An example in the current Te Tau Ihu context (there are no scallops) might be that, in the absence of local scallops, the need for kaimoana is either met from the purchase of alternative food, kaimoana from the supermarket or kaimoana sourced from outside of whānau local areas. The value of whānaungatanga is important here. For example, Ngāti Tama has a close relationship with Ngai Tahu based on whakapapa, trade and projects and may ask and or trade for kaimoana depending on the circumstances for the need for food.

The ability to source kaimoana from local sources will enhance whānau ***Ability to Manaaki (feeding whānau from local sources)***. The need to supplement food needs from other sources diminishes this. The ***Ability to Manaaki (feeding whānau from local sources)*** is an important influence on the ***Wellbeing of Tangata Whenua***(this is the same node already discussed earlier), so having to supplement it from elsewhere will also have a detrimental impact on this wellbeing.

When manaakitia te whānau is provided with scallops/kaimoana, then kaimoana can be provided for wider community food and trade (**B4**). Similarly, if there is insufficient kaimoana, this may or may not

be supplemented from other sources, which is what is occurring in the current Te Tau Ihu context. Generally, whānau have sourced scallops from other sources if there is a significant, special whānau, hapū, iwi occasion and scallops is required to manaaki manuhiri. Alternatively, other kaimoana may be sourced instead of scallops.

If kaimoana is sourced locally then the *Ability to Manaaki (feeding whānau from local sources)* is enhanced, and so is *Wellbeing of Tangata Whenua*. if food has to be supplemented from other sources, then both components are negatively impacted.

These two loops (**B3 & B4**) both make up the larger **B5** loop. This describes how when all needs are met, no more scallops need be taken, thus halting/reducing the amount of scallops removed.

Whānau also noted that customary (pre-European contact) take of scallops may also be used for trade purposes. Under the current legislative management, a customary permit is required to collect kaimoana to give to whānau, hapū and iwi for manaaki purposes at hui, events and tangihanga. No money is exchanged and the kaimoana is given as a koha. This could also be the type of kaimoana take that is explained in the **Fisheries legislative m***anagement* later.

The Food and trade for whānau, marae, hapū, iwi node acknowledges historical barter and trade in pre-European times and the practice continues today. Therefore, whānau aspirations are to restore scallops in Te Tai-o-Aorere ki Mohua to ensure whānau, hapū and iwi have a sustainable supply of scallops for food, customary use and trade.

7.4.7 Fisheries Legislative Management loops

Summary:
- *The Fisheries legislative management loops refer to the various regulatory influences that exist for recreational, customary or commercial take of scallops.*
- *'Customary' refers to Māori customary rights under Te Tiriti and the exercise thereof by whānau, hapū and iwi according to Māori values, tikanga and kawa.*
- *Here, the customary collection of scallops node is a modern take on the hononga kai loops in the preceding section of the causal loop map. It is not intended to represent any additional or duplicate take.*

The **Fisheries legislative management** loops refer to the various regulatory influences that exist for recreational, customary or commercial take of scallops. The regulations are contemporary tools and show the links to the formal codified and prescribed legislated management methods to meet the needs for recreational users, customary or commercial purposes. There may be some overlap between the takes described in these loops and those described in the Hononga Kai loops.

This area is connected to the Te Tiriti o Waitangi loops and represents the settlement of fisheries claims under the Te Tiriti o Waitangi i.e., the 1992 Deed of Settlement that is implemented through the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992, the Fisheries Act 1996 and the Māori Fisheries Act 2004. The loops depict Māori rights and interest, and current legislative levers or barriers (for whānau, hapū and iwi) that inform fisheries management.

Whānau noted that 'customary' refers to Māori customary rights under Te Tiriti and the exercise thereof by whānau, hapū and iwi according to Māori values, tikanga and kawa. They also discussed the artificial separation between customary and commercial fishing and prioritise customary take/allocation over recreation and commercial take within the causal loop map. The Whānau recognised the important role of recreational fishing for Māori coastal communities. However, recreational fishing was conceptualised as those who are not fishing to support Māori coastal communities with limited or no understanding of the tikanga in the rohe moana where they fish. They

also noted that recreational allocation limits set by the Quota Management System (QMS) are arbitrary and a hypothetical figure based on absent data and information. Also, there is no accountability of what taonga species are taken from the moana.

The *Commercial collection of scallops* node is taken into account only after *Te Taiao (Physical)* is healthy and food and trade needs of whānau and community have been met with the supply of scallops. The current Te Tau Ihu context is that there are no commercial takes for scallops, but there are commercial takes for other kaimoana.

The QMS level of scallops node refers to the level of scallops that the QMS perceive to be in existence. If this is high, then this will increase the *Total Allowable Catch (TAC)*, thus leading to greater *Customary*, *Recreational* and *Commercial allocation*. The greater the allocation, the greater the overall collection of scallops and thus scallops removed from te taiao.

The Whānau noted that the TAC is determined by scientists predominantly based on quantitative models as to estimate how much kaimoana is available and can be allocated as a limit of takes. Mātauranga has not informed the development and implementation of the models. Ngāti Tama has a commercial scallop allocation but volunteer to scale back commercial takes to be conservative rather than take the maximum limit. (pers comm F Te Miha/A Stephens).

Whānau noted that they exercise rangatiratanga and volunteer to either take no kaimoana or reduce further the limit they take of kaimoana for customary takes regardless of the QMS limit. Again, the customary take is relative to the needs and or purposes for the kaimoana. Just because there are more scallops in the moana does not mean that whānau will take the maximum limit for customary purposes. Also, whānau spoke of their own integrity and autonomy in decision making and whether to harvest or not from the moana based on a range of Māori values.

Figure 17.   Fisheries legislative management loops
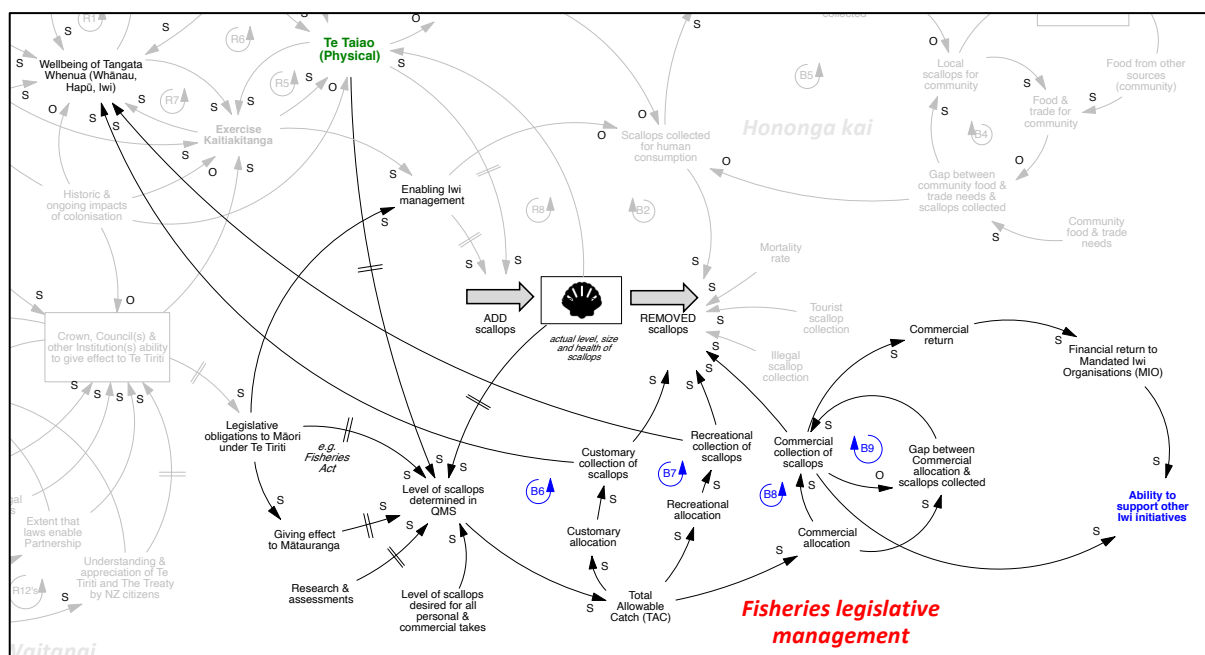
In addition, these loops show causal relationships to how Iwi commercial interests (here referring to interests in fishing) have the ability to support other Iwi initiatives, which are intended to achieve other economic, social, cultural and economic outcomes

As noted earlier, the **customary collection of scallops** node is a modern take on the **hononga kai loops** in the preceding section of the causal loop map. It is not intended to represent any additional or duplicate take.

The quality of the Te Tiriti o Waitangi loops impact the ***Legislative obligations to Māori under The Treaty of Waitangi*** node, which reflects the legislated rights of (or obligations to) Māori. This can allow both an increased level of scallops/kaimoana, as well as an increase in the decision making and participation role of whānau to survey and monitor the health of te taiao and scallops, hence the inclusion of ***Giving effect to Mātauranga*** and ***Research and assessments*** components.

7.4.8 Te Tiriti o Waitangi loops

Summary:

- *There are important differences between Te Tiriti (te reo Māori version) and The Treaty (English version). This causal loop map applies Te Tiriti as its basis.*

- *The quality of the partnership between Iwi and Crown has an important impact on the wellbeing of Tangata Whenua and influences the ability of Crown and council agents to give effect to Te Tiriti.*

- *The historic and ongoing impacts of colonisation have had, and continue to have, a major influence on the quality of this partnership.*

The context for this area is Te Tiriti o Waitangi (the te Reo Māori version) and includes components that refer to The Treaty (the English version) because Crown/Councils operate within the principles of the Treaty. The whānau affirm that Te Tiriti o Waitangi guaranteed tino rangatiratanga (self-governance, self-management and self-determination) and an enduring partnership between Māori and the Crown.

In contemporary environmental management, this means Te Tiriti Partners share the responsibility for co-governing and co-managing te Taiao – the Crown via statutory obligations and Māori exercising kaitiakitanga. The whānau also affirm tino rangatiratanga as kaitiakitanga can't be fully practiced without self-determination and authority.

This group of loops ultimately influences the wellbeing of te Taiao, Tāngata Whenua and wider communities. Barriers include the intergenerational and ongoing impacts of colonisation and institutional barriers that prevent kaitiakitanga and tino rangatiratanga. Ultimately, protecting and enhancing the mauri of te Taiao requires co-governance/co-management Te Tiriti frameworks and urgent action.

Components relating to Te Tiriti o Waitangi (Te Tiriti; te reo Māori version) are very important in the causal map. Whānau discussed the difference between the context and application of Te Tiriti and the English version The Treaty. It is noted that the English version is not a translation of Te Tiriti.

Te Tiriti was written in te reo Māori, understood and signed by Māori chiefs as a symbol of an enduring partnership between Māori and the Crown. As a foundation document for Aotearoa, it envisaged a relationship of mutual benefit between Tangata Whenua and those who came after to Aotearoa, Te Tiriti – Tangata Tiriti[10]. The agreement affirms and protected an enduring power-sharing relationship, with hapū and iwi tino rangatiratanga and customs. Te Tiriti has crucial differences and interpretation, meaning and emphasis to The Treaty. Te Tiriti promised Māori secure tribal tino rangatiratanga and secure Māori land ownership. The Treaty states the British were to protect Māori interests from the encroaching British settlement; provide for British settlement; establish a government to maintain peace and order.[11]

---

[10] Non-indigenous (non-Māori) people of the Treaty

[11] https://waitangitribunal.govt.nz/treaty-of-waitangi/meaning-of-the-treaty/

Table 3 outlines the fundamental difference between Te Tiriti, te reo Māori version and The Treaty, English version. It helps to provide context to whānau narratives for the pilot scallop causal map to give effect tote tino rangatiratanga and Te Tiriti Partners responsibility to co-manage te taiao.

Table 3. Fundamental difference between Te Tiriti o Waitangi and The Treaty of Waitangi

Articles	Te Tiriti o Waitangi Māori text	The Treaty of Waitangi English version
Article 1: British intention of the agreement	Te kawanatanga (governance)	Sovereignty
Article 2: Tangata Whenua/hapū guaranteed; and to regulate land sales	Te tino rangatiratanga (chieftainship) in relationship to ngā taonga katoa (all treasures)	Tangata Whenua have full possession of lands, forests, fisheries, estates and other properties. Voluntary land sales; and Queen has right of pre-emption.
Article 3: Tangata Whenua have the protection of the Queen	Tangata Whenua have the same rights as British people (Oritetanga)	Tangata Whenua get same rights and privileges as British subjects
Article 4: Māori text only.	Māori customs protected; alongside others (Ritenga)	Not in this version.

Te Tiriti confirmed obligations and principles for Te Tiriti partnership model, each party respected for their own autonomy. For whānau, Te Tiriti guaranteed protection of te tino rangatiratanga, Māori values, customary rights and interests. In practical terms, this means whānau exercise kaitiakitanga and rangatiratanga within their rohe and whereby have the authority to make decisions, manage taonga according to Māori tikanga and priorities, on issues that affect them and the natural world and to access and utilise adaptive management practices required to protect, and enhance taonga tuku iho important to them.

The 'Treaty' Principles

It is the 'Treaty' principles (English version) that have evolved over time through successive government policies and Waitangi Tribunal and Court of Appeal rulings that inform Tangata Whenua and Crown relationships, governance and regulation of the natural environment.[12] The three key principles are partnership, participation and protection. The partnership principle requires each party 'to act reasonably, honourably and in good faith'. It is therefore important to consult with Māori at the start of any project, to give effect to meaningful participation and partnership relationships. Active protection requires the Crown to protect Tangata Whenua in the use of their lands and waters.

Partnership is not only the responsibility of Crown agencies at the higher levels of governance, but also within management and our communities - that is between Tangata Whenua and Tangata Tiriti. The latter term refers to non-Indigenous New Zealanders who are in the country by virtue of the Treaty/Tiriti. The notion of Tangata Tiriti, as used notably by Judge Eddie Durie (previous Waitangi Tribunal Chair), underlies partnership and acceptance (King, 2003).

---

[12]   https://waitangitribunal.govt.nz/assets/Documents/Publications/WT-Principles-of-the-Treaty-of-Waitangi-as-expressed-by-the-Courts-and-the-Waitangi-Tribunal.pdf

For whānau, the strength of **Crown, Council(s) and other institution(s) ability to give effect to Te Tiriti** is what protects the rights and interests of whānau, hapū and iwi, and is required to recognise their desire to exercise a range of customary rights in fisheries management. As one participant said "it is important for the new Minister to understand the Treaty partnership…the Minister and staff do not come from the same baseline understanding of the Treaty partnership… portfolios change in the Crown with new Ministers and staff interpretation of the Treaty relationship is variable…" (pers comm F Te Miha 2020).

Kaitiaki also exercise rangatiratanga and mana to uphold tikanga and exercise kaitiakitanga within their specific rohe. Within a contemporary context whānau haukainga have autonomy and decision-making roles for their rohe. They also belong to Iwi entities, that have their own autonomy and decision-making roles across a wider tribal area.

Post settlement iwi governance entities currently manage the ettlement redress and Treaty legislative mechanisms with Crown and Council agencies. For a list of the post-treaty settlement entities of Te Tauihu, refer to Appendix 6.

Given this context, the whānau described three key components in the pilot map that impacted whānau decision making roles and participation in marine management. They include:

a. How well Te Tiriti is given effect to by Crown and council agents (described by ***Crown, Council(s) and other institution(s) ability to give effect to Te Tiriti***);

b. The **quality of the partnership between Iwi and Crown** and its impact on the wellbeing of tangata whenua;

c. The **historic and ongoing impacts of colonisation**.

The third of these factors, ***historic & ongoing impacts of colonisation***, the colonial history of Aotearoa and the resulting impact of colonisation on Tangata Whenua, has been discussed briefly earlier in section 0. In Te Tauihu, the power sharing promises of Te Tiriti were never realised and subsequent extensive land losses and commodification of the natural environment as a 'resource', an inanimate object without regard for Māori values.

The process of colonisation fundamentally undermined and dislocated Tangata Whenua relationships with their spiritual and physical tūpuna whenua and moana.

The ***Te Tiriti o Waiangi loops*** describe the circular and reinforcing (R) influence between the remaining two factors above: the ***Quality of the Partnership between Iwi and Crown***; and ***Crown, Council(s) and other institution(s) ability to give effect to Te Tiriti***. As well as how these components are themselves influenced by the ***Historic & ongoing impacts of colonisation***.

The loops highlight the barriers to whānau expression of tino rangatiratanga and mana Motuhake. The ***Quality of the Partnership between Iwi and Crown*** is impacted by the variable baseline standards of engagement with Māori by ***Crown, Council(s) and other institution(s) to give effect to Te Tiriti,*** which is a barrier to whānau and iwi realising the full potential of ***Iwi involvement in decision-making***. Both components inform and impact the ***Level of trust between Iwi & Crown*** which in turn feeds back and impacts on the ***Quality of the Partnership between Iwi and Crown***.

These are reinforcing loops, so they can reinforce in either a positive or negative direction. When various component components are in a healthy state (co-governance and co-management models) they further enable each other; when various component components are in an unhealthy state (Māori exclusion from decision making processes), they further erode each other.

Figure 18. Te Tiriti o Waitangi loops

Te Tiriti o Waitangi
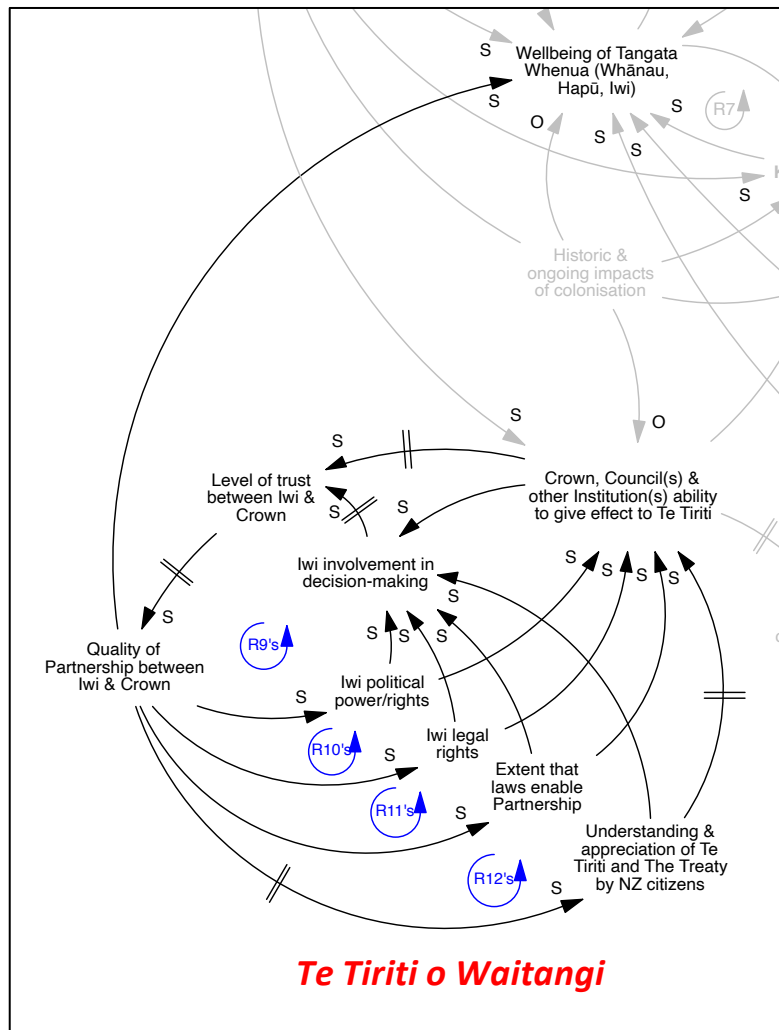
Four broad ways of reinforcing on each other were identified. The pluralisation of these loops (e.g. R9's) indicate that there are a variety of pathways within the loops. All loops involve the impact that the *Level of trust between Iwi & Crown* has on *Quality of partnership between Iwi & Crown*. However, there are a variety of ways that either or both of *Crown, Council(s) and other institution(s) ability to give effect to Te Tiriti* and *Iwi involvement in decision-making* may be incorporated in the loops.

The four pathways identified were via: *Iwi political power/rights* (**R9's**); *Iwi legal rights* (**R10's**); the *Extent that laws enable Partnership* (**R11's**); and *Understanding and appreciation of Te Tiriti and The Treaty by NZ citizens* (**R12's**).

This final loop (R12) is very important. The Crown and councils have failed to promote proactively Te Tiriti and the Treaty settlement relationship to the public in a positive way. The mutual benefit principle requires mutual obligations and responsibilities and benefits to support both Māori and non-Māori. The greater the extent of tauiwi (non-Māori) commitment to acknowledge and recognise mātauranga and Te Tiriti, then the greater tauiwi respect and appreciate and are aware of te ao Māori and how the natural world is to be respected for the life-supporting qualities it provides to human beings and all living things; and the reciprocity value of the koha of the natural world to humans and our collective responsibility and obligation to reciprocate, respect and care for the natural world.

This approach further reinforces the *Crown, Council(s) and other institution(s) ability to give effect to Te Tiriti*. This is an important loop as it recognises the role that public political power and opinion has on Māori aspirations for partnership; and public political power and opinion is an enabler of political will to give effect to Māori aspirations. An important insights from these loops is that the **quality of the partnership between Crown and iwi,** is influenced by the public and not just the Crown and Iwi.

Whānau noted that 'NZ citizens' must be defined to mean non-New Zealanders who have New Zealand citizenship. Those people who are non-New Zealanders and live in New Zealand and do not have New Zealand citizenship are excluded from this definition. It was an important point because of the concern that non-New Zealanders would have political power over Māori rights and aspirations and that approach was not acceptable.

7.4.9 How the Te Tiriti o Waitangi loop links to the rest of the map

Summary:

- *The quality of the partnership between Iwi and Crown, manifested through the ability of Crown and council agents to give effect to Te Tiriti <u>influence</u>:*
  - *The Crowns legislative obligations to Māori.*
  - *Māori ability to exercise kaitiatitanga.*
  - *The wellbeing of tangata whenua.*
- *The quality of the partnership between Iwi and Crown, manifested through the ability of Crown and council agents to give effect to Te Tiriti <u>is influenced by</u>:*
  - *Mātauranga.*
  - *The historic and ongoing impacts of colonisation.*

Two components from within the partnership loops influence out to other parts of the map; while two components from other parts of the map influence into the partnership loops.

The two components within the Te Tiriti loops that link to other parts of the map are: the ***Crown, Council(s) and other institution(s) ability to give effect to Te Tiriti***; and ***Quality of partnership between Iwi & Crown***. These are shown in Figure 1.

If there is an increase in the baseline standard for ***Crown, Council(s) and other institution(s) to give effect to Te Tiriti***, then the inference is that the link would maximise implementing ***Legislative mechanisms that give rise to obligations to Māori****,* which in turn would influence the role of Māori in **Fisheries legislative management loops** described earlier.

Whānau noted that councils are local body agents and there are no proper baseline engagement protocols because decision makers decide how and when they will engage with Māori and on issues determined by them. As a result, decisions may impact on Māori but decision makers do not seek Māori input and evaluation or minimise consultation processes to tick box exercises. For example, seeking Māori to provide feedback on a proposal rather than engage Māori at the beginning of the process.

Further, Whānau noted every Council does not work to the same baseline standard for Māori engagement protocols. Each Council will have different interpretations by different decision makers on consultation and engagement protocols. Councils also do not go to the Crown to seek guidance and direction and Crown do not have national policy statements on best practice Māori engagement protocols to direct and guide councils. Whānau suggest the current RMA reforms may be an opportunity to address and strengthen Māori interests and values to lift the standard for enduring Te Tiriti partnership relationships and decision making to benefit not only Māori but the wider community and ultimately the natural environment.

Similarly, any improvement in lifting the baseline standard for ***Crown, Council(s) and other institution(s) to give effect to Te Tiriti***, would also increase whānau **exercise kaitiakitanga node**. In turn, this would have a positive impact on ***Te Taiaio (Physical)***.   This is because the greater the willingness and implementation of **Crown and agencies to give effect to Te Tiriti**, the greater the ability of whānau to enact partnership relationships and models to enact tino rangatiratanga and **exercise kaitiakitanga** giving effect to te ao Māori values, tikanga, kawa.

Secondly, the ***Quality of the Partnership between Iwi & Crown*** has a direct impact on the ***Wellbeing of Tangata Whenua***. If Te Tiriti partnership models are implemented in natural environmental management, laws, education, health, social, economic processes then the corresponding benefits contribute to Tangata Whenua physical and spiritual wellbeing.

Figure 19.   How Te Tiriti loops connect with other parts of the causal loop map

Te Tiriti o Waitangi
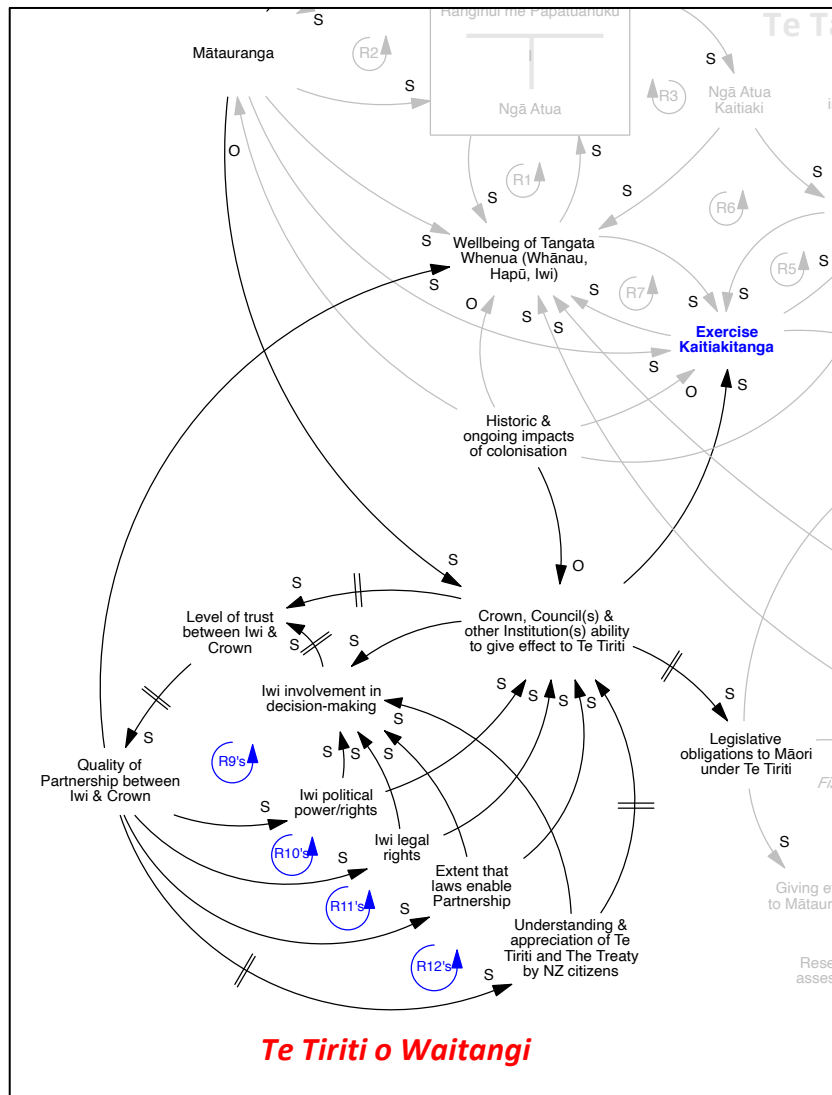
Other components that directly influence the Te Tiriti/ The Treaty loops from Te Taiao loop are *Mātauranga* and the *Historic and ongoing impacts of colonisation*.

National policy statements that direct agencies to include *Mātauranga* in governance and management decisions will enable and maximise *Crown, Council(s), and other Institution(s) ability to give effect to Te Tiriti*. If *Mātauranga* is acknowledged and recognised at a national level then the greater the opportunity to maximise mechanisms for the *Crown, Council(s), and other Institution(s) ability to give effect to Te Tiriti/ The Treaty* and improvements in the health and wellbeing of Te Taiao.

As noted earlier, colonisation is not simply an event that occurred in the past, it has very real intergenerational and legacy effects which remain active today. If the *ongoing impacts of colonisation* continue, then the *Crown, Council(s), and other Institution(s) ability to give effect to Te Tiriti* remains minimal and unacceptable to whānau.

The more that the institutional barriers and *impacts of colonisation* can be addressed and minimised or removed, to give effect to whānau expression of tino rangatiratanga, then the greater incentive for the *Crown, Council(s), and other Institution(s) ability to give effect to Te Tiriti*. These historic and ongoing impacts have minimised the ability of whānau to protect their values and decide, participate, contribute, share, inform, apply mātauranga, to enlighten Crown and Council governance and management.   As a result, whānau must confront and navigate the continued institutional oppression of their cultural identity, te reo Māori, Māori values, autonomy, authority, tino rangatiratanga; and the decline and poor health of their taonga species, te Taiao and whānau, hapū and iwi.

The following whānau narratives from the He Pou Tokomanawa Report 2019 reaffirm the sentiments described in this section.

> "Despite these many achievements, Ngāti Tama [whānau] abilities to fulfil the responsibilities of kaitiakitanga in Te Tai-o-Aorere ki Mohua remain hampered so long as their tino rangatiratanga is not guaranteed. An interviewee recognised the strong connections that

Ngāti Tama whānau have to the sea, yet argued that it was not acknowledged or represented in terms of real agency, of decision-making powers and influence in governance relationships: "We get to input into things [i.e. policy, plans, etc.], but we don't control it." The interviewee claimed: "It's about a sense of agency, it's about authority, it's around who decides, and who decides who decides. […] We're kaitiaki, but we don't have the agency or authority in a lot of situations. We do in terms of tikanga, of course, and in terms of tūpuna, but in terms of the bloody law [we don't]."

A suggestion that Ngāti Tama seek a representative as a councillor in local government politics was dismissed as ineffectual: "…one person, so you're out-voted to start with." "What's that one iwi person going to do when you've got how many councillors?" One iwi representative on behalf of Manawhenua ki Mohua (a collective of three iwi) was part of the Takaka FLAG process, yet involvement in stakeholder groups has been interpreted by some as compromising iwi's Treaty partnership status. As an interviewee put it: "Well, you're a Treaty partner, but you're not sitting above them [stakeholder groups].

7.5 The complete pilot causal loop map – a whānau perspective for Te Tai-o-Aorere ki Mohua

Figure 20. Large version of the pilot causal loop map – a whānau perspective for Te Tai-o-Aorere ki Mohua
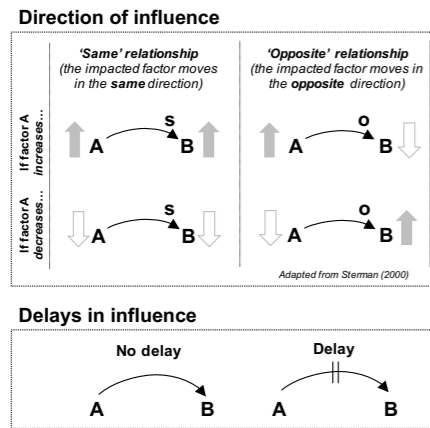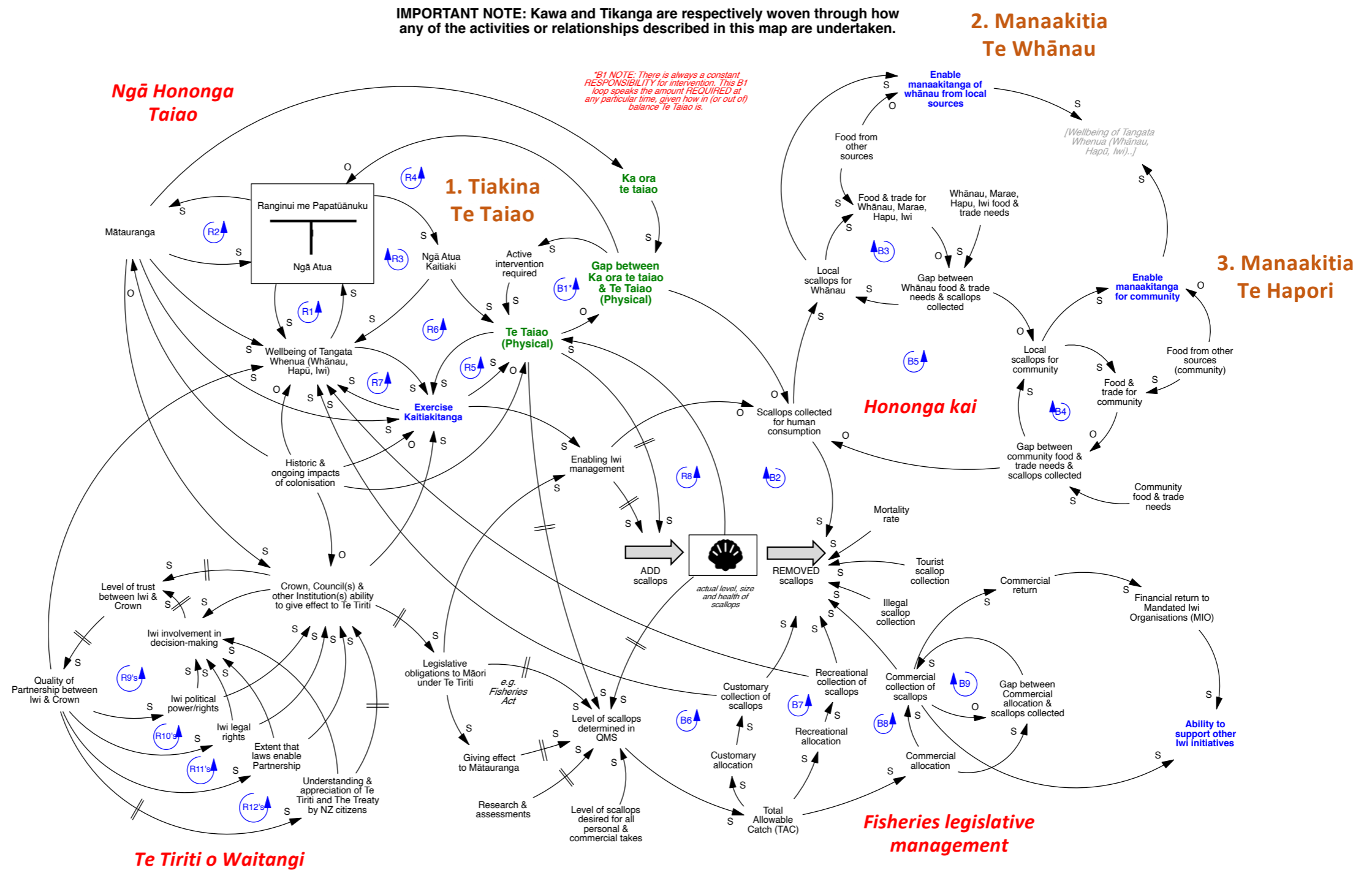
8 So what? How to use the map to explore different possible futures

Summary:

- *The visual articulation of complexity via a causal loop map and the process used to develop it provide insight in their own right. Yet there are layers of insight that can be gained from a causal loop map. These are:*

  - *A visual demonstration of the complexity/ interconnected nature of the issue.*

  - *The circular nature of causality is highlighted. This enables both 'internal' and 'external' influences to be identified and considered accordingly.*

  - *The causal loop map can support a discussion around how key factors or components might change over time, based on the influences mapped out. This is important because it returns the discussion to talking about trends over time.*

  - *Discussion of trends over time can be aided by the qualitative 'analogue simulation'. This is a subjective discussion about how variables will respond over time to influences, supporting by informal sketching of anticipated changes over time.*

  - *One or multiple causal loop maps may provide a common reference and evaluation system that can be applied (and inform) across multiple tools, from multiple perpectives.*

The process of developing a causal loop map itself has many benefits (e.g. building shared understanding of issues, articulating how causal factors are believed to operate, etc). Yet the resulting map is only part of the output –**insights from a causal loop mapping process come when that map is used to explore the potential changes over time of key area(s) of interest in response to change.** This section describes a qualitative process for using the causal loop map to gain such insight into potential future dynamics from exploring multiple interventions. This process is referred to here as *analogue simulation*. Unfortunately, in this pilot, there was insufficient time to apply this process with the whānau, however an example exercise was undertaken with the authors to demonstrate the concept.

The map offers a way for describing various loops and supports a holistic view in which participants can identify for themselves the outcomes they want to have balanced or prioritised. *Analogue simulation* essentially helps participants to step from the *process* of developing the map to *using it to gain insights into dynamic behaviour over time*.

8.1 Different ways of gaining insight from a causal loop map

Appendix 1 described how causal loop maps, like that described in this report, sit at the lower end of the spectrum of complexity amongst the use of System Dynamics tools. As you move up the spectrum of complexity small-scale simulation models can be developed, and eventually larger-scale and more complex simulation models. However, not all causal loop maps can be turned into simulation models given the nature of their content. The causal loop map described in this report is one such example of this – where there is no intention (nor would it be considered possible) to turn such a map into a simulation model.

Yet low complexity does not mean that only low levels of insight or stakeholder alignment are achieved. Often the opposite is true – significant insight and stakeholder alignment can be gained from

participatory processes that developed system maps, for comparatively much lower levels of resource than those required to develop complex simulation quantitative models.

Insight can be achieved in a variety of ways, each building upon the other. All of these are subjective and are listed below:

1. At the very least, the causal loop map helps visually demonstrate the interconnected nature of the factors being mapped.

2. Causal loop maps also highlight the circular nature of causality, where it has been able to be identified. This allows insight into how much behaviour amongst variables comes from endogenous versus exogenous influence. This can help reframe participants perceptions of how much influence is from 'external' sources and how much is from 'within'.

3. Using the causal loop map as a tool to guide discussion, the anticipated dynamic behaviour of some elements in the map can be discussed and explored as a group. The development of a causal loop map is usually anchored around discussing the trends of behaviour in key variable(s) up until this point in time (see Appendix 1). From this point in the process, the discussion is now anchored around how the variables may behave or change *from this point onwards in time*, effectively bringing the discussion back full circle to talking about trends over time.

4. This discussion of trends over time can be aided by the use of a technique referred to here as *analogue simulation*. This is effectively the same subjective discussion about what the dynamics of the inter-connected variables will do in the future, yet it is aided by the use of sketching out anticipated changes over time on qualitative graphs. This is obviously a manual process that is intended as a an additional, pragmatic, 'hands on' aid to increase insight and learning.

The process outlined in the following section describes point 4 outlined above. While this was not able to be undertaken in this pilot with the whānau, the authors undertook a test of how that might work, to demonstrate the process.

For a more detailed description of how this has been applied elsewhere on the Challenge, refer to the report of the application of this in the Hawke's Bay EBM case study.[13]

8.2 How analogue simulation can be used

The feedback loop approach recognises that nothing is static and that rather things are constantly changing as they are in, or out of, balance. Describing feedback loops seeks to articulate circular cause and effect that helps to explain how variables of interest present as patterns of behaviour over time. Analogue simulation is a qualitative and subjective, yet deliberately pragmatic and applied, attempt to explore what possible changes might be in response to changes or interventions. Thus, analogue simulation is a tool that supports both the discussion that people have to explore what the impact of any changes might be; as well as the result of this exercise being a participant developed, visual articulation of what those changes might be.

The approach can be used as simply as articulating potential changes over time as a sketch; or a more formal scale might be used with some form of tokens/counters. The former is described here as it was not considered appropriate to quantify, even informally or relatively, changes in many of the elements described in this causal loop map.

---

[13] At the time of writing, the Hawke's Bay EBM case study had completed an initial Phase 1, where a causal loop map was developed, and this analogue simulation technique was demonstrated but not fully applied. Phase two, where this technique would be used more fully, was in the process of being delivered. For a detailed description of Phase 1, see Connolly et. al, *Hawke's Bay EBM case study - Part 1: System mapping to understand increased sedimentation and loss of benthic structure in the Hawke's Bay*. Please note that this was applied by a stakeholder forum with Māori participants therefore not a Te Tiriti based approach as advocated by the whānau within this pilot.

8.2.1 Process used

To demonstrate the process of analogue simulation the following was undertaken:

- A selection of variables within the causal loop map were identified along with an anticipated intervention to explore.

- For each set of variables, a blank graph template was drawn up, with the Y axis being the relative change of variables and the X axis being time. Where the X and Y axis intersected was the present. A series of relevant timesteps were marked out on the X axis – e.g. 5 years, 10 years, 15 years etc.

- Sketch out a baseline. Talk through and sketch the anticipated behaviours of variables under a 'business as usual' (BAU) scenario. That is, all current issues and influences remain unchanged.

- Sketch out the interventions. Working through each intervention (or combination of interventions) in turn, and using the causal loop map as a guide, the flow on effect of relative changes from the intervention are sketched out in the selected variables. For instance, variable X might start low but over time, due to the additional inputs of variable Y, this might trend upwards. This process is carried out over a reasonable timeframe to explore the potential impacts of change.

Figure 21.   Analogue simulation – example template
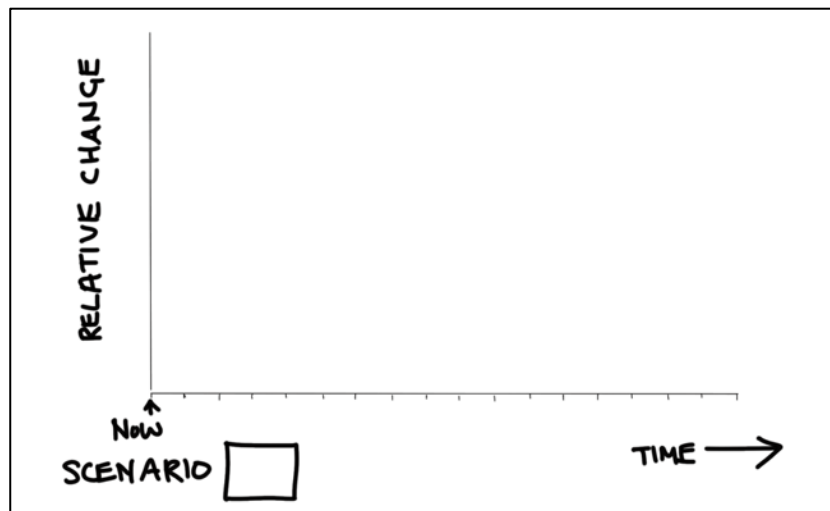
8.3 Example results from analogue simulation using the Te Ao Māori causal loop map

The authors only explored the below as a way of demonstrating the analogue simulation technique. There was not time or resources to involve other kaitiaki, so this exercise should be read simply as a hypothetical demonstration of the types of insight that analogue simulation can provide.

The three following examples were explored:

1. A BAU approach, where no major change was implemented and current conditions and trends persisted;

2. The level and appreciation of mātauranga held by whānau was actively increased; and

3. The quality of the Te Tiriti partnership was actively improved.

The resulting graphs are shown and described below. Changes were discussed over hypothetical 30-50 year timeframes.

8.3.1 Business as usual (BAU)

The BAU approach assumes that no major changes to existing trends are undertaken or achieved. However, this does not mean that the current level of various factors remain static at the levels that they currently are. It can be assumed that even under a BAU approach, some variables will experience change.

For example, While the BAU example assumes that there is no major change in the status of trust between Iwi and Crown Te Tiriti partners, and that the current quality of the partnership remains relatively where it is.

Under such assumptions discussion focused on the level of scallops as an indicator of the general health of te Taiao and the subsequent impact of this on the wellbeing of Tangata Whenua. Discussion also considered how potential changes in these would impact their ability to tiaki, Manaakitia te Whānau (meet the food needs of their whānau, marae, hapū, Iwi) and Manaakitia te Hapori (meet the food needs of the wider community).

During the discussion it was considered that the expected trend of scallop recovery would continue to be low but that it would be expected to increase slightly over the next 25-30 years. This would reflect ongoing but gradual progress that would be made from current activities such as research and restorative interventions. However even over a 50 year timeframe the recovery of the scallop population was expected to be low and likely to still not be enough to provide for Manaakitia te Whānau and Manaakitia te Hapori, let alone a reopening of the scallop fishery. Consequently, Manaakitia te Whānau and Manaakitia te Hapori lines are expected to remain static at a low level of relative strength.

It was also recognised that, given the existing levels of activity that are going into various forms of environmental restoration or activity (e.g. the National Policy Statement for Freshwater Management), then it would be reasonable to expect other environmental improvements over the coming decades, even if that was not experienced with scallops. As a result the Te Taiao line trends upwards at a similar or faster rate than scallops, as scallops is only one contributor to this.

Figure 22.   Analogue simulation – business as usual (BAU)
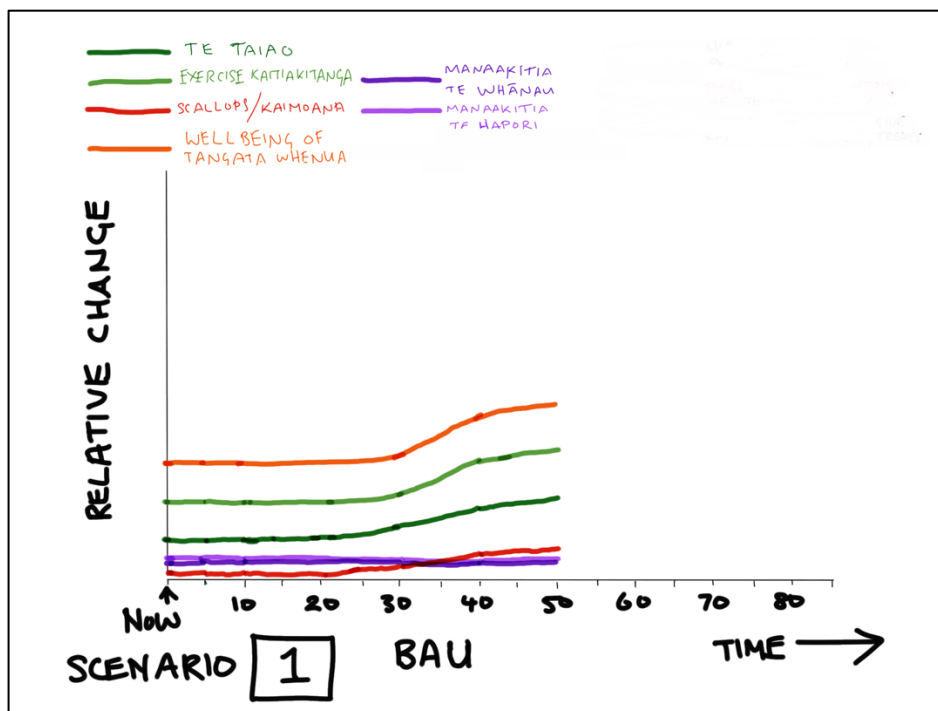
Even in the absence of scallop recovery, improvements in the mauri of Te Taiao due to other environmental recovery would be expected to have positive flow on effects. This would occur through the immediate feedback of any improvement in the mauri of te taiao to lead to an improvement in the exercise of kaitiakitanga (R5) which would also flow on to improve the wellbeing of tangata whenua in a spiritual and cultural sense (R7). Further, any improvements in te taiao would also strengthen the mauri of Ranginui and Papatūānuku which, in turn, would also strengthen the wellbeing of tangata whenua. As a result, a slightly larger increase in the wellbeing of tangata whenua is observed.

This highlights how even small impacts in environmental health can cascade and accumulate through various influences to improve the spiritual and cultural components of the wellbeing of tangata whenua, even in the absence of physical improvements (i.e. scallops to eat).

8.3.2 Actively increasing Mātauranga

The second hypothetical example explored by the authors was to actively increase the level and appreciation of mātauranga held by whānau.

To achieve this, it was assumed that there would be an active push to teach mātauranga to an increasing number of whānau over the period of several decades. While mātauranga is highly valued within whānau, it was also considered that there would be a push to ensure its appreciation amongst a wider group of whānau and those associated with them.

As a result, a significant increase in mātauranga was anticipated. The level at which this would be expected to increase would exponentially strengthen due to the feedbacks associated with tangata whenua wellbeing and the increased mauri of Ranginui and Papatūānuku.

The discussion highlighted that for a short while, any initial increase in mātauranga could be expected to have a certain amount of positive impact on the ability of Crown, Council(s) and other institution(s) ability to give effect to te tiriti/the treaty. This would also increase tangata whenua ability to exercise kaitiakitanga, both directly and via flow on impacts from an improvement in the Crowns ability to give effect to te tiriti/the treaty.

Figure 23.   Analogue simulation – actively increasing mātauranga
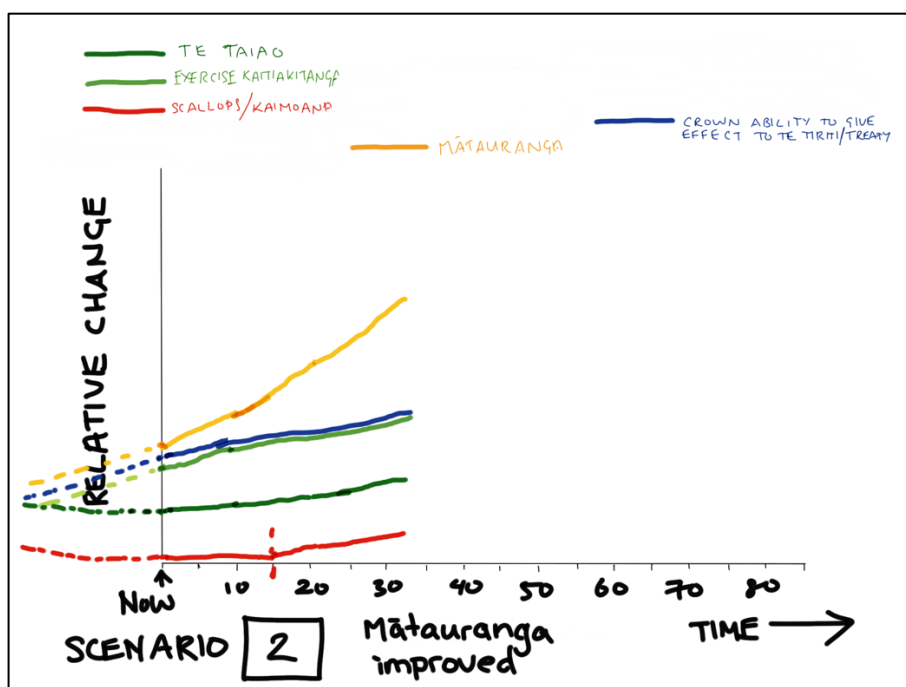
Yet it was also considered that while a certain level of increased mātauranga would help improve these other factors, this would only improve them a bit. For longer term impact from that increase level of mātauranga to be realised, it there would also need to be an active increase in the ability of give effect to te tiriti/the treaty via other means. This includes improving Iwi's political and legal rights, laws that enable partnership, and improving the broader appreciation that citizens have of te tiriti/the treaty.

This discussion highlighted that any increase in mātauranga would only be impactful up to a certain point. For greater impact, change would need to occur in other areas.

8.3.3 Actively improving Quality of partnership between Iwi & Crown

The third example that was explored was to actively improve te tiriti/the treaty partnership between Iwi & the Crown.

Building off the previous example, this factor was seen as a key leverage area for realising improvements in a wide range of factors. This was considered especially true for the direct involvement in the management of natural resources (exercise kaitiakitanga) and the flow on effects that this would have on tangata whenua health and wellbeing.

It was noted that this factor has been trending in an upwards direction in recent decades. So active improvement of this factor was seen as improving on this trend that had been experienced in recent years. As a result, this light pink line was identified as gradually moving upwards in a wavey line pattern. The wavey line indicated periods where this relationship remained static for periods of time and then was actively improved through an assumed effort on behalf of the government at the time.

The intensity of this change was also seen as wavey due to the changing of governments and the needs to re-establish relationships every two or three election cycles. It should be noted that this does not suggest that relationships only improve under a certain type of political leadership, but that it is trend that will experience periods of advancement and periods of remaining the same.

What did become obvious from this exercise was the impact of the short timeframes of electoral cycles. The lines in the graph change direction far more quickly, in response to the 3 year election cycles. Previous trends had been talked about over 5-10 year timeframes.

As the light pink line representing the quality of the partnership is improved, the Crown ability to give effect to te tiriti/the treaty will follow, generally with a lag of a few years (to allow for legislation etc to be passed). This means that the Crown ability to give effect to te tiriti/the treaty and consequently the exercise of kaitiakitanga, will over time come up to the quality of the partnership, but not exceed it. They are dependent on that in order to enable further improvements.

Figure 24.   Analogue simulation – actively improving the te tiriti/the treaty partnership
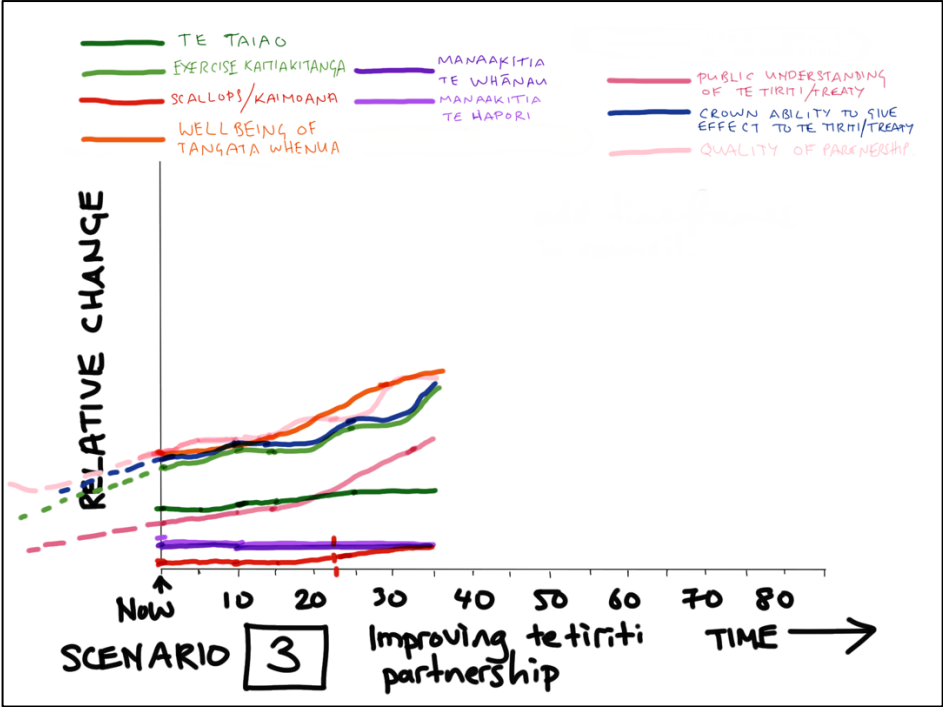
As a consequence of the improvement in the quality of the Iwi & Crown partnership and also probably partly because of it, the public understanding of te tiriti/the treaty experiences a large improvement. The actual health of te taiao will likely improve slightly, in line with other improvements noted earlier, and scallops will also likely experience a similar slow recovery curve. In all likelihood, the ability to manaakitia te whānau and manaakitia te hapori shall remain low for some time. However, the positive spiritual, cultural and identity impacts on tangata whenua wellbeing from improvements in the Iwi & Crown relationship will have a significant impacts and should not be underestimated.

8.3.4 Summary of analogue simulation process

The use of this approach is intended as a pragmatic way of exploring possible futures within minimal resource use. The application of analogue simulation does not preclude the use of any further, more complex and resource-intensive simulation modelling. Yet it may help to reduce the variety of, or focus the intent of, further investigations and modelling.

It is useful because it helps to highlight the dominant feedback loops that are operating across the map that has been developed. This can help focus attention on where to best target interventions - i.e. are they targeting the most impactful feedback loops? Exploring the changing dynamics of variables, based on the map, should be the intent of any causal loop mapping exercise, whether it is done formally or not, as it helps to demonstrate how the map can be used and informs further work.

8.4 A tool to connect and understand causality across multiple perspectives

The reader is reminded that this pilot was the second of two pilots in the use of causal loop mapping as part of Phase I of the Challenge. Participants in the earlier CP2.1 pilot project were selected based on either their institutional knowledge (i.e. they were from a Crown agency, council or research institute) and/or science knowledge (a large version is reproduced in Appendix 7).

Both maps are reproduced together here, to demonstrate how they may be used to explore learning at the intersection of different perspectives, as described at the outset of this report.

Both maps have the representation of scallops as a stock (a box) with an inflow and an outflow (arrow in and arrow out). It was suggested that this common feature of the maps may be used as a link between the them. This would provide an opportunity for discussions relating to the flow on impacts of the various influences described, could be impacted by influences from another perspective. A conceptual demonstration of how these two maps might be used together is shown in Figure 26. Here, a change in node A on one map could be followed through to impact on node B on the other map.

SUSTAINABLE SEAS

69

Piloting the use of Systems Mapping in the Sustainable Seas National Science Challenge
Causal Loop Mapping Pilot – a whānau perspective for Te Tai Aorere ki Mohua

Figure 25. The two causal loop maps from the two pilots (initial pilot at top, whānau perspective at bottom)
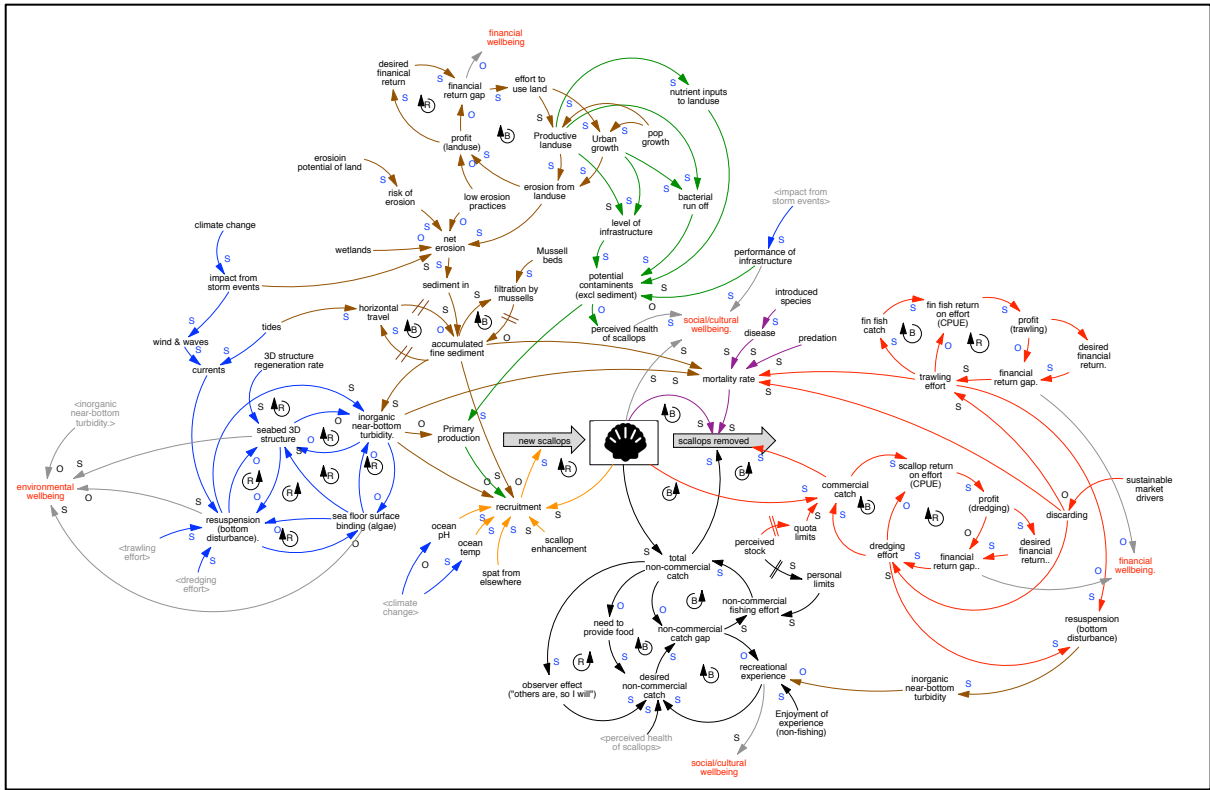
SUSTAINABLE SEAS

70

Piloting the use of Systems Mapping in the Sustainable Seas National Science Challenge
Causal Loop Mapping Pilot – a whānau perspective for Te Tai Aorere ki Mohua
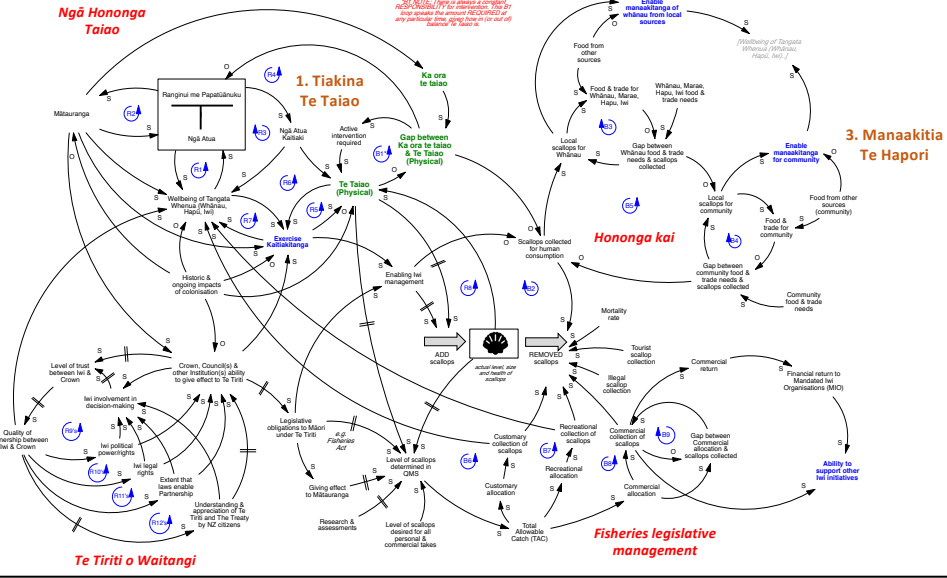
Figure 26.   Conceptual articulation of how the two causal loop maps from the two pilots may be used together
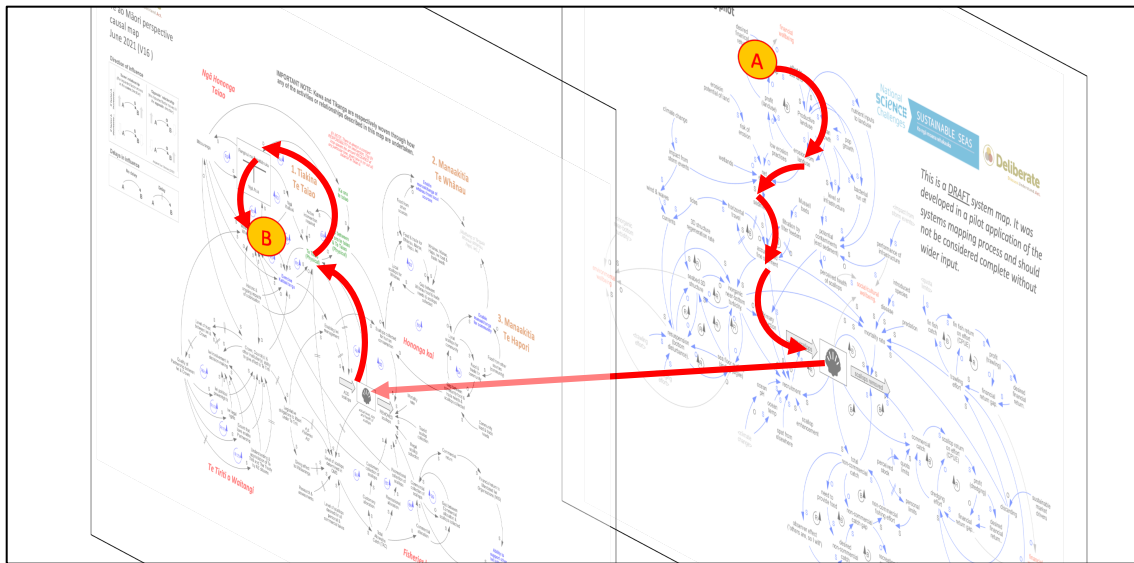
This is only an example of how such an approach might work. This was not tested in this pilot, but it remains a potential area for future exploration.

As a qualitative tool, causal loop mapping can help explore possible futures from the map, via informal 'analogue simulation'. This may also provide a common reference and evaluation system that can be applied across multiple tools, includes te ao Māori values and mātauranga and potentially enable feedback mechanisms to and from other methods, including more quantitative computer simulation models.

9 Summary and recommendations

This report has described a pilot process of applying causal loop mapping tools (qualitative systems thinking tools form the discipline of System Dynamics) to the issue of the decline of scallops/kaimoana in Te Tai-o-Aorere ki Mohua.

The process has faced resourcing challenges throughout due to (amongst other things) the COVID-19 pandemic as well as the health and family circumstances of key participants. The patience and support of the Challenge management to complete the pilot is gratefully acknowledged.

A series of workshops and working sessions with whānau, as well as working sessions between the authors, developed the causal loop map. This summarises how a range of factors are inter-related.

Casual loop mapping was able to:

- Visualise the interconnectedness of the spiritual, physical health and wellbeing relationships between Ranginui me Papatūānuku, Ngā Atua, Ngā Atua Kaitiaki, Tāngata Whenua through whakapapa and how a change in the health and wellbeing of one will result in a similar change in the health and wellbeing of the others.

- Highlight the degradation of species or resources involves recognising the broader implications for the entire ecosystem and human communities.

- Demonstrate that there are layers of qualitative and quantitative knowledge.

- Visualise a more holistic understanding of Te Ao Māori, and legal and ecological "systems" and their interconnections as understood by Te Tai-o-Aorere ki Mohua whānau.

- Support shared understanding about the actions required to move toward desirable alternative futures. The causal loop map is a tool to explore potential changes over time.

The key findings are outlined according to: Whakapapa; Four key causal loop map areas - Ngā Hononga Taiao, Hononga Kai, Te Tiriti o Waitangi and Fisheries Management Legislation; Possible Futures; and a Summary of learnings and recommendations resulting from the pilot causal loop mapping process.

Whakapapa

Whakapapa is at the heart of the causal loop map. Whakapapa is the genealogical lineage and connection to 'Ranginui me Papatūānuku', their many children – 'Ngā Atua', and the divine processes that physically manifest in te Taiao (the natural world) including all living and non-living resources. It is through whakapapa to ngā atua, (including Tangaroa - atua of the sea, rivers, lakes and creatures that live within them) that Tāngata Whenua (the whānau within this project) inherit their birth right and duty as kaitiaki of their respective rohe that includes Te Tai-o-Aorere ki Mohua.   Therefore, degradation of one species or resource is understood in terms of the negative impacts to the whole living system and to people themselves.

Four key causal loop map areas

There are four key areas that nest cultural values and perspectives within the causal loop map:

1. **Ngā Hononga Taiao (red title):** Whakapapa and obligations to uphold and nurture the interconnected spiritual and physical relationships of Ranginui me Papatuānuku, Ngā Atua, te Taiao (the natural world) and Tāngata Whenua.

    Mātauranga encapsulates te ao Māori, and interrelationships support te Taiao and Tāngata Whenua wellbeing, necessitating the exercise of kaitiakitanga as an expression and

demonstration of tino rangatiratanga. This is a reciprocal relationship as tino rangatiratanga and Mana Whenua and Mana Moana provides the authority for kaitiakitanga to be exercised.

Tiakina te Taiao (orange title) – respect and nurture te Taiao in accordance with kawa and tikanga customary practices.

2. **Hononga kai (red title):** The loops in this area focus on the provision of scallops/ kaimoana, a fundamental tāngata whenua value, right and practice. It highlights the priority aspirations for whānau, marae, hapū and iwi which is to uphold the mauri of Te Tai-o-Aorere ki Mohua. It recognises the rights of tāngata whenua to exercise kaitiakitanga, manaakitanga and decision making to maintain a healthy and sustainable supply of scallops/kaimoana.

Manaakitia te whānau (orange title) – manaakitanga and acts of caring for and giving scallops/kaimoana to support the wellbeing of other whānau, hapū, iwi, manuhiri.

Manaakitia te hapori (orange title) – manaakitanga and acts of caring for and giving scallops/kaimoana to support and care for the wellbeing of the wider community.

3. **Te Tiriti o Waiangi (red title):** The foundation for this area is Te Tiriti o Waitangi (the te Reo Māori version), including components that refer to The Treaty (the English version), as the Crown and Councils operate within the principles of the Treaty. The whānau assert that Te Tiriti o Waitangi guarantees tino rangatiratanga (full self-governance, full self-management, and full self-determination) and establishes an enduring partnership between Māori and the Crown.

In contemporary environmental management, this partnership necessitates shared responsibility for co-governing and co-managing te Taiao – the Crown fulfilling statutory obligations and Māori exercising kaitiakitanga. The whānau also affirm tino rangatiratanga is essential for the full practice of kaitiakitanga, as self-determination and authority are interdependent.

This interconnected area of loops ultimately influence the wellbeing of te Taiao, Tāngata Whenua and wider communities. However, barriers such as the intergenerational and ongoing impacts of colonisation and institutional racism hinder kaitiakitanga and tino rangatiratanga. Protecting the mauri of te Taiao requires co-governance and co-management within Te Tiriti frameworks, demanding urgent and decisive action.

4. **Fisheries legislative management (red title):** This area is connected to the Te Tiriti o Waitangi loops, representing the settlement of fisheries claims through key legislative instruments i.e., the 1992 Deed of Settlement that is implemented through the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992, the Fisheries Act 1996 and the Māori Fisheries Act 2004.

The loops depict Māori rights and interests in fisheries while also highlighting the legislative levers or barriers impacting whānau, hapū and iwi. For example, the need for mātauranga Māori to inform fisheries management; commercial fishing allocation limits through the Quota Management System are negatively perceived by whānau due to their experience and the state of fisheries. Further barriers include processes that continue to minimise whānau and hapū participation in local fisheries governance and management.

The whānau also discussed the artificial separation between customary and commercial fishing and prioritise customary take/allocation over recreation and commercial take within the causal loop map. They recognise the important role of recreational fishing for Māori coastal communities, contrasting it with the activities of those who fish without understanding or respecting the kawa and tikanga in the rohe moana.

Ultimately, the effective management of fisheries under Te Tiriti necessitates legislative frameworks and management practices that genuinely uphold kaitiakitanga.

Potential futures

The whānau conveyed the need to identify and understand different actions to help address the decline of scallops/kaimoana within Te Tai-o-Aorere ki Mohua. While this was not able to be piloted with the whānau, the authors tested a range of alternative possible futures using the causal loop map approach outlined in Section 8 of this report (p.62).

The process begins with a focus on the challenges being addressed as an articulation of trends of behaviour over time (in this case an historic decline in the health of kaimoana within Te Tai-o-Aorere ki Mohua). The causal loop map was then used to track the causal influences understood to be affecting the health of scallops/kaimoana, and graphs were sketched to support discussions about and potential interventions that could address the degradation of kaimoana within Te Tai-o-Aorere ki Mohua.

Natural resource problems and their management processes are most often informed by scientific methods of future scenario testing that use various types and complexity or analytical inference under different management scenarios. Therefore, increasing capability and accessibility to qualitative tools, whilst appropriately enabling te ao Māori values and perspectives to be identified and explored is critical to improve health of scallops/kaimoana within Te Tai-o-Aorere ki Mohua.

This project has shown how important it is to create an empowering Māori (whānau, hapū, iwi) approach and space for the whānau to familiarise and explore the causal loop mapping tool. Consequently, the two CP2.1 causal loop maps present a potential cross-cultural approach to understanding the influences on scallops/kaimoana within Te Tai-o-Aorere ki Mōhua.

To build on these causal loop maps it would be useful to identify a full suite of restorative scenarios and actions over time that are required to reduce key areas/pressures. Together, they could support deeper understanding of the decline of scallops/kaimoana and provide a common evaluation and reference system that could inform more quantitatively complex models. Finally, using the causal loop map to explore possible futures is a critically important intent of the approach and the process should always end with some version of this.

Figure 27.   Using the casual loop map to envisage potentially different futures
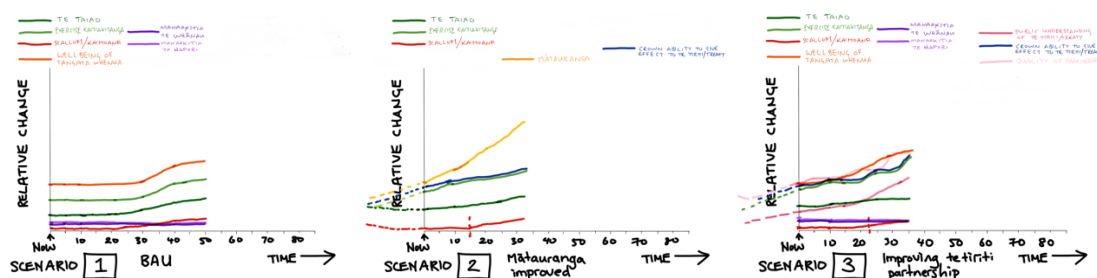
In addition to being used to explore possible futures via 'analogue simulation', causal maps may also provide a common reference and evaluation system that can be applied across multiple tools, includes te ao Māori values and mātauranga and potentially enable feedback mechanisms to and from other methods, including quantitative computer simulation models.

Summary of learnings and recommendations resulting from the pilot causal loop mapping process.

A summary of learnings from this process has been collated in the table below. Adjacent to them are a set of recommendations for how to best use the causal loop mapping process and/or the insights gained from this pilot process. The recommendations below are a mix of specific and generalised

recommendations for the Challenge to consider. Some are specific to this causal loop mapping project, and others are more general.

Table 4. Summary of learnings and recommendations from the pilot causal loop mapping process

Learnings	Recommendations
Co-design, Co-development and Te Ao Māori commitment Any future causal loop mapping with whānau, hapū and iwi necessitates a Māori approach and commitment to embed te ao Māori at its heart, recognise Te Tiriti o Waitangi, and create an empowering cultural space. It is important to apply good research practice when co-designing, and co-developing a project with whānau, hapū and iwi as offered in the Rauika Māngai, the Cross-National Science Challenge Māori Leadership guide to Vision Mātauranga (Rauika Māngai, 2019).	1. To ensure that research projects are relevant to whānau, hapū and iwi partners, they must be co-designed, co-developed and appropriately resourced.
Context: Hapū and iwi are confronted daily with an excess of proposals e.g., natural resource use, development, and research requests. At a strategic level, there was a lack of understanding and trust by some whānau participants about the Challenge, how it may contribute to Te Tau Ihu Iwi priorities, issues and aspirations and the relationship of the Challenge with the Crown agencies and Councils. The authors consider that causal loop mapping has the potential to build capability for cross-cultural dialogue. However, it is important to enable an empowering Māori approach and space for the whānau to familiarise and explore the tool and develop a shared understanding of the decline of scallops/kaimoana and future possibilities. It is also important to contextualise any actual or perceived limitations of this approach with whānau, hapū and iwi at the beginning of a co-design process. For example, to clarify if hapū and iwi are comfortable to inform a causal loop map with their mātauranga as the tool and language used is articulated and understood within the western science discipline of System Dynamics. The methodological approach of causal loop mapping requires components (e.g., mātauranga) to be identified in such a way that any change in them could be described as an increase or decrease. At times, this caused discomfort with the whānau as it required them to 'translate' and compartmentalise te ao Māori and their interrelationships into 'components' that can go up or down.	2. Challenge research projects and potential tools like causal loop maps need be situated within the specific cultural context of the whānau, hapū, iwi research partners. 3. To build trust and confidence with Te Tau Ihu Iwi, the Challenge should share the Te Tau Ihu project outcomes in a manner that can contribute to Te Tau Ihu Iwi priorities, issues and aspirations. 4. It would be helpful to situate causal loop mapping approach within a high-level overview of the suite of marine management tools/models that are currently contemplated through research or applied in Aotearoa/NZ marine management processes e.g., spectrum of qualitative to quantitative tools, purpose, how it works, complexity, uptake, advantages, limitations.

Learnings	Recommendations
There is a range of influence and ability that Māori and non-Māori practitioners have to enable the inclusion of mātauranga within modelling processes e.g., whānau, hapū, iwi having no involvement in modelling; being general participants in collaborative modelling processes; including mātauranga within a western science conceptual model; penultimate development of a te ao Māori approach. As a qualitative tool, causal loop mapping can help explore possible futures from the map, via informal 'analogue simulation' that may also provide a common evaluation and reference system that includes te ao Māori values and mātauranga and enable feedback mechanisms from more quantitative computer simulation models. It is also important to acknowledge that there can be a limit to the number of 'inputs' and 'outputs' in a causal loop map, as more complex and detailed maps can be difficult to interpret. The strength of information could be limited, as there may be selection biases or subjectivity with elicited opinions.	
Whanaungatanga: If there is no prior relationship between whānau, hapū, iwi, facilitator/researchers, time and care will be required to build trust and understanding of each other's backgrounds and roles in order to agree research objectives, tasks and process.	5. Research (by the Challenge or other providers) need to invest time to establish and build familiarity/trust between participants, facilitators, and researchers. 6. Guidance is needed on appropriate engagement, co-design/co-development, and implementation of research with whānau, hapū, iwi.
Complimentary project team: The team needs to include members who are culturally and subject area competent. This would enable rich dialogue between the whānau and facilitators to build on a platform of shared understanding in workshop settings.	7. Projects of this nature require co-facilitators who are ideally culturally and subject area (e.g., causal loop mapping) competent. 8. There needs to be a pre-requisite for facilitators to at least have an understanding of te ao Māori values and perspectives to aid quality discussion. This level of understanding is likely to vary - especially amongst non-Māori facilitators. A co-design and co-development process would identify the cultural competency level of the team and support that may be required.

Learnings	Recommendations
Inadequate timeframe and budget: There were compressed timeframes to implement the workshops, introduce new tools and language to the whānau and explore their application. The whānau had to help build the cultural capability of the facilitator through the process (and vice versa for the facilitator to build causal loop mapping tool capability). The authors and whānau acknowledge that there was some budget for whānau participation and co-author roles.	9. As above, to ensure that projects are relevant to whānau, hapū, iwi partners, they must be co-designed, co-developed and appropriately resourced. This would have enabled a better research process and shared learning.
Final causal loop map debrief: Time and resource pressures did not allow for a debrief of the final causal loop map tool with the whānau. This should still be held to go over the results of the trial causal loop map and to check for understanding, relevance, and application for whānau to evaluate the benefits of the tool.	10. If desired by the whānau, a debrief should be held to go over the final system map and to check for understanding, limitations and application in their respective work.
Communication tools: The causal loop map is considered a useful tool by the authors. However, it can be overwhelming as a single image and difficult to understand if people are not familiar with the approach. It is best understood when explained in narrative and accompanied by anecdotes of how factors interact and influence behaviours and trends. The lead facilitator 'held the pen' with regards to the causal loop mapping tool computer application. As such any small or large changes e.g., due to misinterpretation or spelling had to be communicated to and actioned by the lead facilitator.	11. Communication tools that support both the process itself, as well as disseminating the outputs for whānau, hapū, iwi need to be developed e.g., story map, audio-video explanations and narratives for different parts of the map and the insights it provides. This will help to explain the causal loop map, to see it, hear it, feel it. 12. Explore the potential to enable shared access for project leaders/facilitators to the causal loop mapping tool computer application.

Learnings	Recommendations
Given aforementioned challenges, this pilot was only able to progress with the development of the causal loop map itself. Generating qualitative insights about different possible futures from the map, via informal sketched temporal graphs (referred to in the report as 'analogue simulation') supported by rich discussion, were not completed in this pilot. This is an important step in the process of causal loop mapping and should not be neglected because it ties the process and the resulting causal loop map back to exploring anticipated or desired changes over time. It can also help provide a common evaluation and reference system that could inform more quantitatively complex models.	13. Ensure that the causal loop map is used as a way to support kōrero around possible futures. The map is a tool to support these kōrero and this needs to be better understood at the beginning, by both sponsors and participants, as a key outcome. This helps leverage the understanding of causality jointly developed into an outcome of shared understanding of potential actions required to move into a more desirable potential future. 14. Consideration should be given to running temporal graphing or 'analogue simulation' sessions with the whānau participants and/or others, to demonstrate the use of the tool and explore alternative futures. 15. Explore the potential to co-design and co-develop a 'whole cycle' qualitative (causal loop map) and selected quantitative approach on an issue with whānau, hapū, iwi and/or others. The causal loop map could be used as a common evaluation and reference system that could inform more complex quantitative computer simulation models.

10 References

Connolly, J.D. (2017). *Group model building to understand 'wicked' problems in New Zealand freshwater management* (Master's thesis, University of Waikato, Hamilton, New Zealand). Retrieved from https://researchcommons.waikato.ac.nz/handle/10289/11570

Connolly, J.D., Lundquist, C.J., Madarasz-Smith, A. & Shanahan, R. (2020). *Hawke's Bay EBM case study - Part 1: System mapping to understand increased sedimentation and loss of benthic structure in the Hawke's Bay.* (A report for the Sustainable Seas National Science Challenge). Hamilton, New Zealand: Deliberate.

Deliberate. (2018). Conceptual options for incorporating Systems Thinking into Project CP2.1 of the Sustainable Seas National Science Challenge. Hamilton, New Zealand: Justin Connolly.

Deliberate. (2019). *Piloting the use of Systems Mapping in the Sustainable Seas National Science Challenge*. Hamilton, New Zealand: Justin Connolly.

Fisheries New Zealand. (2019). *Draft Southern Scallop Strategy: Marlborough Sounds*. Marlborough Sounds, New Zealand: Fisheries NZ/Tini a Tangaroa Southern Scallop Working Group. https://www.mpi.govt.nz/dmsdocument/35490-Draft-Southern-Scallop-Strategy-2019

Ford, A. (2010). *Modeling the environment* (2nd ed.). Washington, D.C.: Island Press

Heke, I., Rees, D., Swinburn, B., Waititi, T., Stewart, A. (2019). Systems Thinking and indigenous systems: native contributions to obesity prevention. *AlterNative, 15*(1), 22–30. doi: 10.1177/1177180118806383

Hewitt, J., Faulkner, L., Greenaway, A. & Lundquist, C. (2018). Proposed ecosystem-based management principles for New Zealand. *Resource Management Journal, November 2018*, 10-13. Retrieved from https://www.rmla.org.nz/wp-content/uploads/2018/11/RMJ-November-2018_copy.pdf

Howitt, R. and Suchet-Pearson, S. (2003). Ontological pluralism in contested cultural landscapes. In: Anderson, K., Domosh, M., Pile, S., Thrifts, N. (Eds) Handbook of cultural geography. SAGE Publisher, London, 557-569

King, M. (2003). *The Penguin History of New Zealand*. ISBN 0-14-301867-1, p.167

Ministry for Primary Industries. (2017). *Survey of scallops in SCA 7, January 2017: New Zealand Fisheries Assessment Report 2017/23*. Wellington, New Zealand: Williams, J.R., Parkinson, D.P., Drury, J., Roberts, C.L., Bian, R., Tuck. I.D.

Ngāti Tama ki Te Waipounamu Trust. (2018). *Ngāti Tama ki Te Waipounamu Trust Environmental Management Plan 2018*. Nelson, New Zealand. Retrieved from Ngāti Tama: https://ngatitama.nz/te_taiao/

Passl, U., & Manawhenua ki Mohua . (2019). *Manawhenua Mātauranga Report, For the Tākaka Catchments*. June 2019. Richmond. NZ: Tasman District Council.

Rauika Māngai. 2019. A Guide to Vision Mātauranga: Lessons from Māori voices in the New Zealand science sector. Rauika Māngai, Wellington: 79. Link: http://www.maramatanga.co.nz/sites/default/files/Rauika%20Ma%CC%84ngai_A%20Guide%20to%20Vision%20Ma%CC%84tauranga_FINAL.pdf

Scott, R.J., Cavana, R.Y., & Cameron, D. (2013). Evaluating immediate and long-term impacts of qualitative group model building workshops on participants' mental models. *System Dynamics Review, 29*(4), 216–236. doi: 10.1002/sdr.1505

Scott, R. J., Cavana, R. Y., & Cameron, D. (2016). Recent evidence on the effectiveness of group model building. *European Journal of Operational Research, 249*, 908-918. doi: 10.1016/j.ejor.2015.06.078

Senge, P.M. (2006). The fifth discipline – the art and practice of the learning organisation (2nd ed). London, United Kingdom: Random House.

Sterman, J. D. (2000). *Business dynamics: Systems thinking and modelling for a complex world*. New York, NY, USA: McGraw-Hill.

Sunde C, Astwood J-R, Young A. (2019). He Pou Tokomanawa – Kaitiakitanga in Practice Project Report for the Sustainable Seas National Science Challenge. Prepared as part of the Sustainable Seas National Science Challenge, funded by the Ministry of business, Innovation and Employment. Tiakina te Taiao Report. 45 p. plus appendices.

Te Tau Ihu Statutory Acknowledgements Statutory Acknowledgements of the Resource Management Plans of Marlborough District Council, Nelson City Council and Tasman District Council (2014).

Tatauranga Aotearoa , S. (2019). Our Marine Environment 2019. New Zealands Reporting Series. Ministry for Environment.

van den Belt, M. (2004). *Mediated modelling: A system dynamics approach to environmental consensus building*. Washington, DC, USA: Island Press.

Vennix, J. A. M. (1996). *Group model building: facilitating team learning using system dynamics*: Wiley.

Zanotti, L., Palomino-Schalsha, M. 2006. Taking different ways of knowing seriously: cross-cultural work as translations and multiplicity. Weaving Indigenous and sustainability sciences to diversify our methods. Sustainability Science, 11, 139-152.

Appendix 1   The fundamentals of causal loop mapping (systems thinking)

At the core of system mapping is the desire to visually articulate the relationships between variables that best explain the behaviour that you are trying to understand. This visual articulation of relationship is known as 'causal structure'[14].

This appendix outlines important fundamental elements of causal structure. These are: feedback loops; how they are correctly annotated; the use of the 'goal/gap' structure (as this can explain how different loops dominant at different times); and stock & flow notation.

It also outlines how the causal loop mapping tool sits at the lower end of a spectrum of quantitative rigour, within the tools of System Dynamics. This demonstrates how causal loop maps can be used to inform or work alongside other types of research and methods.

Feedback loops – the basic building blocks of a system map.

Causal loop mapping is especially interested in systems where loops of causality are identified – these are called *feedback loops.* There are two types of feedback loops, *reinforcing* and *balancing* (Senge, 1990).

Figure 28.   The two types of feedback loops
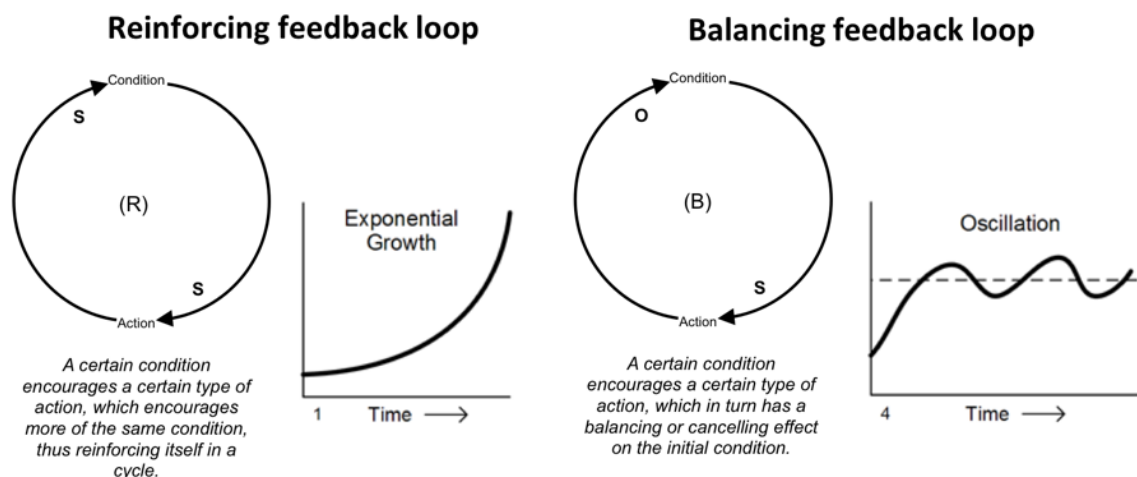
Adapted from Senge (1990) & Ford (2010)

In a *reinforcing feedback loop*, the direction of influence provided by one factor to another will transfer around the loop and influence back on the originating factor in the *same* direction. This has the effect of *reinforcing* the direction of the original influence, and any change will build on itself and amplify. ***Reinforcing loops tend to drive growth or decline***.

A simple example of a reinforcing loop is money in a bank account earning interest. Assuming no withdrawals, the *more* money in the bank then the *more* interest earned, thus resulting in *even more* money in the bank. This influences back on itself in the *same direction* and has the effect of compounding on itself.

---

[14] In the discipline of System Dynamics this is known as 'system structure'. Given the discomfort with the word system described earlier, in this report it is referred to 'causal structure'.

In a *balancing feedback loop*, the direction of influence provided by one factor to another will transfer around the loop through that one factor (or series of factors) and influence back on the originating factor in the *opposite* direction. This has the effect of *balancing out* the direction of the original influence. **Balancing loops tend to create *control, restraint or resistance*.**

A simple example of a balancing loop is thermostat controlled heating. Let's say that the room temperature *drops* so the thermostat clicks on and *generates heating*, this *increases* the room temperature room, so the thermostat clicks off, *stopping the heating*. This has the effect of cancelling itself out.

Feedback loops can be made up of more than two variables and can be linked together to form a causal loop map. How these interact in a wider network of loops provides insight into the influences that may be causing a behaviour we are trying to understand.

Labelling variables

An important concept within causal loop maps is the concept of accumulation (or decumulation) –where does stuff build-up (or decrease) in the interconnected influences? The simple analogy of a bathtub is often used to describe this (see section 0 for further explanation of the bathtub analogy).

In causal loop maps, this concept of accumulation is captured by describing variables in such a way that their name implies that they can *increase or decrease*. This means that they should be described as *nouns*; have a clear sense of *direction*; and/or have a normal sense of direction that is *positive*. Examples to demonstrate this are shown in Figure 29.

Figure 29.   Labelling variables
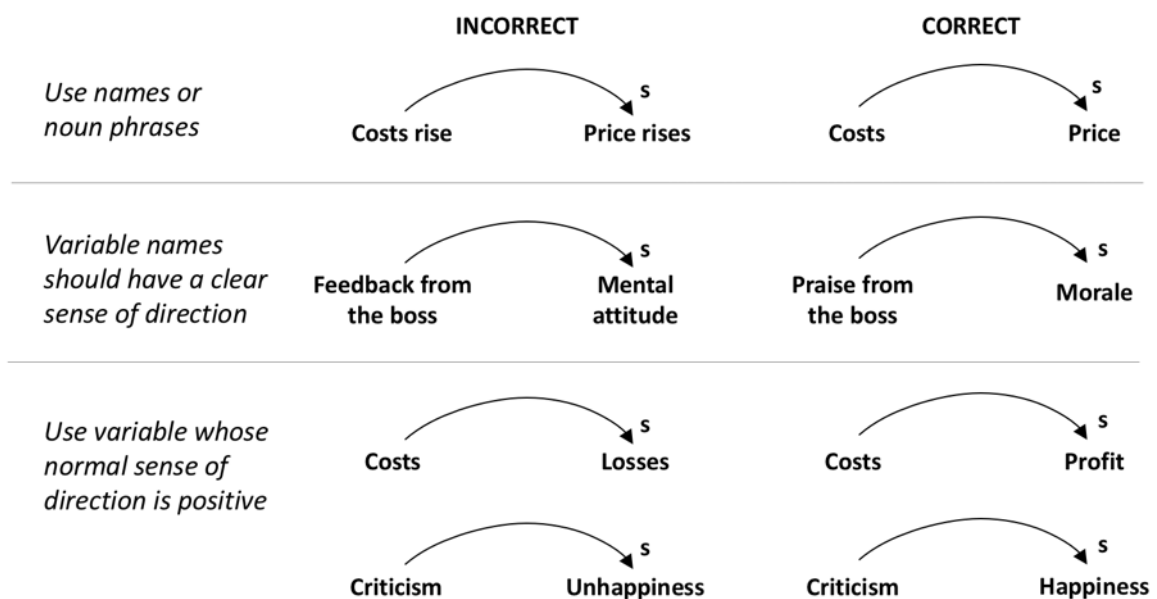
Adapted from Sterman (2000)

Annotating loops

Variables within causal loop maps are connected (and made into feedback loops) by arrows, which indicate that one factor has a causal relationship with the next. These arrows are annotated with either an **'s' or an 'o'** which stands for **'same' or 'opposite'**. These terms correspond to the direction of change that any change in the first variable will have on the second variable.

SUSTAINABLE SEAS   82   Piloting the use of Systems Mapping in the Sustainable Seas
                                                                National Science Challenge
                                                                Te Ao Māori perspectives and Causal Loop Mapping Pilot

For example, if a directional change in one variable leads to a directional change in the next variable in the *same direction*, it is a *same relationship*. Likewise, if the second variable changes in the *opposite direction*, it is an *opposite relationship*. See Figure 30 for a visual description.

Figure 30.   How arrows are labelled in system maps

Adapted from Sterman (2000)
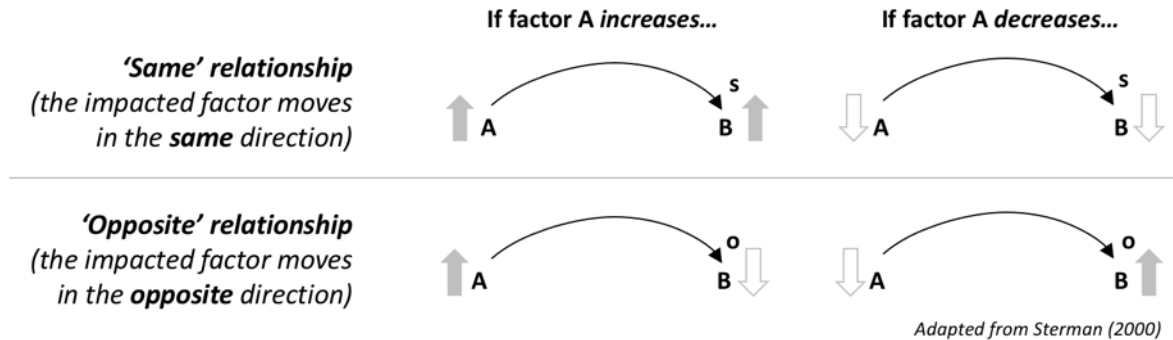
If there is a notable *delay* in this influence presenting in the second variable, when compared to the other influences described in the causal loop map, this is annotated as a *double line crossing the arrow*. An example of this is shown in Figure 31.

Figure 31.   How delays are annotated on arrows

Goals and gaps – driving individual loop dominance.

Realising that multiple loops are operating together to generate the behaviour you are trying to understand is the first useful insight of causal loop mapping. A further useful insight is understanding that not all loops operate at the same strength all of the time. Different loops can dominate at different times. For example, the behaviour generated by your causal loop map might be dominated by a period of growth, but when some kind of physical limit is approached (e.g. the available space in a pond for algae to grow) a balancing loop will start to dominate, therefore slowing the rate of growth.

One useful mechanism for gaining insight into the strength of a balancing loop is the *'goal/gap'* structure. This is a node that combines both a *desired or aspirational level* of something (a 'goal'), with an *actual level* of something. This *difference between these variables* is the 'gap' between the desired/aspirational and actual levels.

The higher the desired level and the lower the actual level, **the greater the 'gap' or difference**. This usually leads to continued or stronger activity to increase the actual level, or to reduce the desired level – effectively any activity that seeks to narrow the gap/difference between desired and actual.

The lower the desired level and the higher the actual, **the lower the 'gap'**. This usually leads to a decreased activity to increase the actual level, as it is near its goal.

SUSTAINABLE SEAS   83   Piloting the use of Systems Mapping in the Sustainable Seas
National Science Challenge
Te Ao Māori perspectives and Causal Loop Mapping Pilot

Figure 32.   Example of a 'goal/gap' structure in a system map – pouring a glass of water
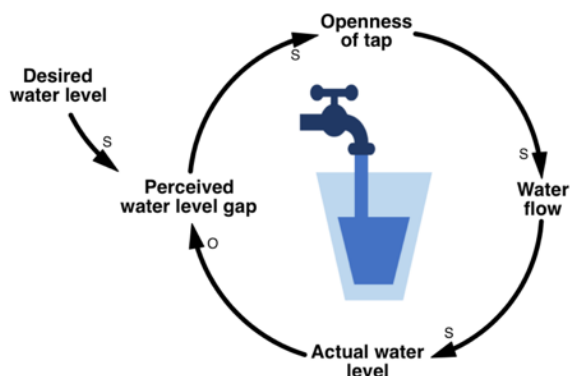
Adapted from Senge (1990)

An example is shown in Figure 32 which shows the simple conceptual example of filling a glass of water. Initially, while the gap/difference between the desired and actual water level is high, the tap will be opened more. As the desired level of water is approached the gap/difference reduces, so the tap is closed further, until it is fully closed when the water level reaches the desired amount.

The 'goal/gap' mechanism can be seen in several places in the causal loop map described in this report.

Stock and flow notation

The bulk of the causal loop map outlined in this report is made up variables and arrows as described above. Such variables are the standard for causal loop maps. However, in some places selected variables are described in a slightly more involved way, known as stock and flow notation, which provides an improved level of insight to understanding the behaviour of interest.

Using a stock and flow notation is similar to a metaphorical *bathtub* (as mentioned earlier). A stock might be anything that we are interested in – number of people, quality of water, level of morale, etc. **But stocks can ONLY increase through more inflow (the tap in a metaphorical bathtub), and ONLY decrease through more outflow (the drain in a metaphorical bathtub), or whatever you are interested in – just like the level of water in a bathtub**. This is reflected in the diagrammatic description of a stock and flow (Figure 33).

Figure 33.   Stocks and flows – the more advanced notations used in System Dynamics
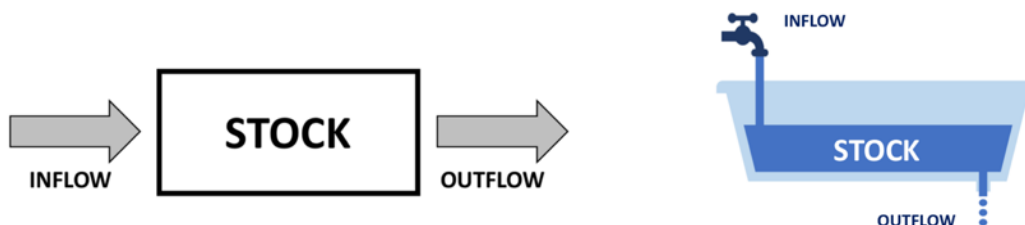
Both basic causal loop maps and more complicated stocks and flow diagrams explain the same type of behaviour. Yet the inclusion of stocks and flows allow a greater level of insight to understand whether a change in a stock is due to a change in *inflow* or a change in *outflow* (see Figure 34 for an example).

In this report, the use of stock and flow notation has been included for the original central variable of scallops. This provides a way to link this map to the other map developed in the original pilot.

SUSTAINABLE SEAS   84   Piloting the use of Systems Mapping in the Sustainable Seas
                                                                                National Science Challenge
                                                                                Te Ao Māori perspectives and Causal Loop Mapping Pilot

Figure 34.   Comparison of reinforcing loops: Causal loop maps vs. Stock and flow diagrams
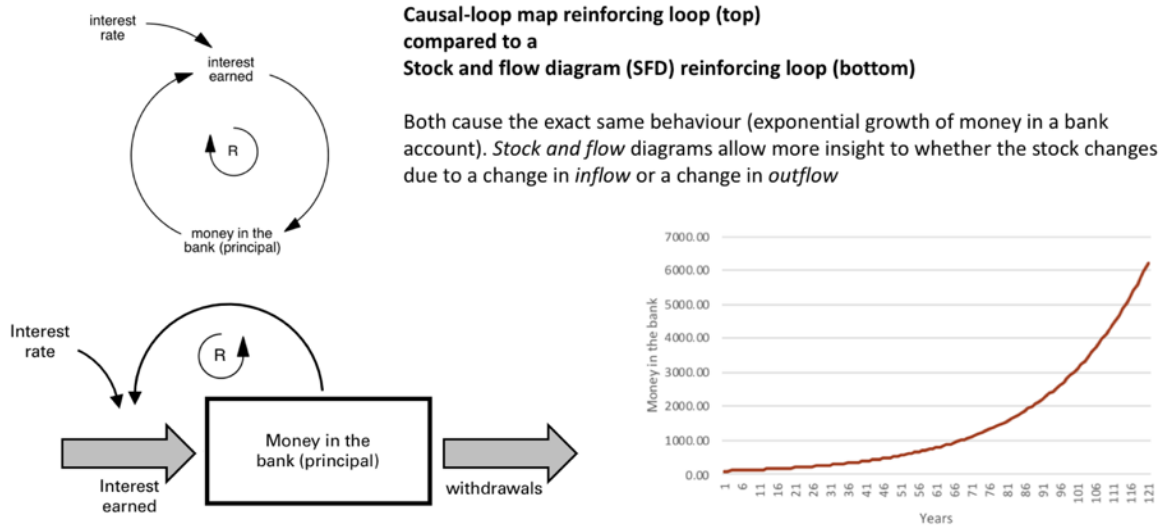
Stocks and flows are the language of simulation modelling in System Dynamics. If the map in this report (or others) was ever to be developed into quantitative simulation modelling (although this is not what is proposed here), then full stock and flow formulation would need to be used. This spectrum of complexity within the tools of System Dynamics is explained in the next section.

How causal loop maps can be used

This section briefly outlines how causal loop maps themselves fit within a spectrum of quantitative rigour in the discipline of System Dynamics; and how they may be used in conjunction with other methodological approaches.

Causal loop maps on the spectrum of quantitative rigour within System Dynamics

The tools of System Dynamics themselves exist on a spectrum of quantitative rigour. These are shown in Figure 35 and simply highlight how these varying tools can demonstrate the same behaviour of interest, and to make the point that *causal loop maps are not the ONLY possible output from the use of System Dynamics tools*.

Figure 35.   System Dynamics tools exist on a spectrum - Causal loop maps, Stock and flow diagrams, and Simulation modelling.
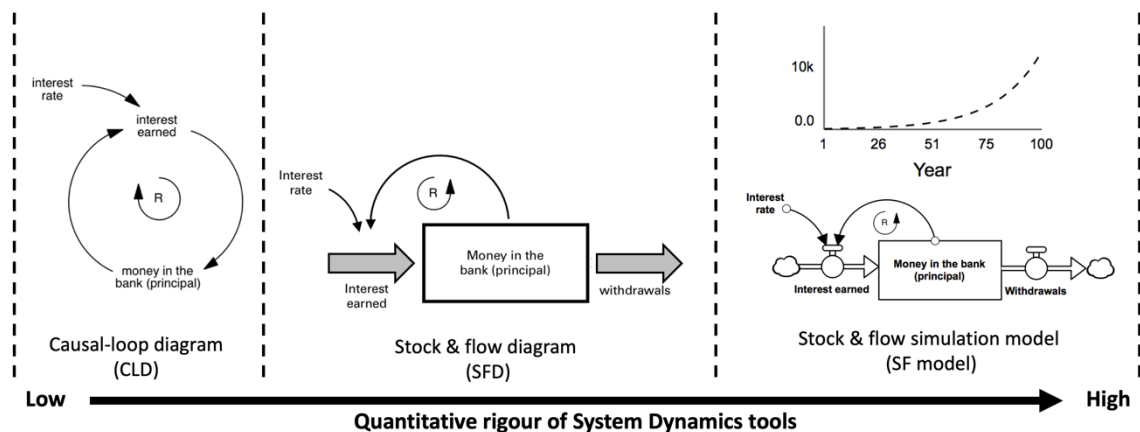
The causal loop map developed here, exists at the conceptual (low quantitative rigour) end of this spectrum. These can range from using the simple dynamics of a single feedback loop to demonstrate a type of behaviour, to multiple loop maps – themselves reasonably complex.

The next steps up in quantitative rigour are Stock and Flow Diagrams (SFD). While *scallops* are represented in this map using stock and flow notation, the map itself is not considered a full SFD. This is because SFD usually contain multiple stocks of interest (although not all factors need to be stocks) and their architecture tends to represent a greater level of mathematical functionality, as SFD tend to be qualitative representations of the actual functions and equations that would be represented in a stock and flow model.

Computer simulation modelling (based on the stock and flow formulation) is the next step in quantitative rigour – that is, actually turning these diagrams into simulation models (if desired). There is huge variability in the types of simulation models that can be developed, with some people advocating that large system insights can be gained from using small scale models (Meadows, 2008), to others demonstrating the utility of large scale and highly complex simulation models (Sterman, 2000).

How causal loop maps may link with other methodological approaches

While causal loop mapping can lead to more complex stock and flow diagrams and simulation modelling within System Dynamics, it may also link with or inform other methodological approaches within a wider research project. A diagram outlining how this can work is shown in Figure 36 and is explained below.

Figure 36.   How systems mapping can link with other research methodologies
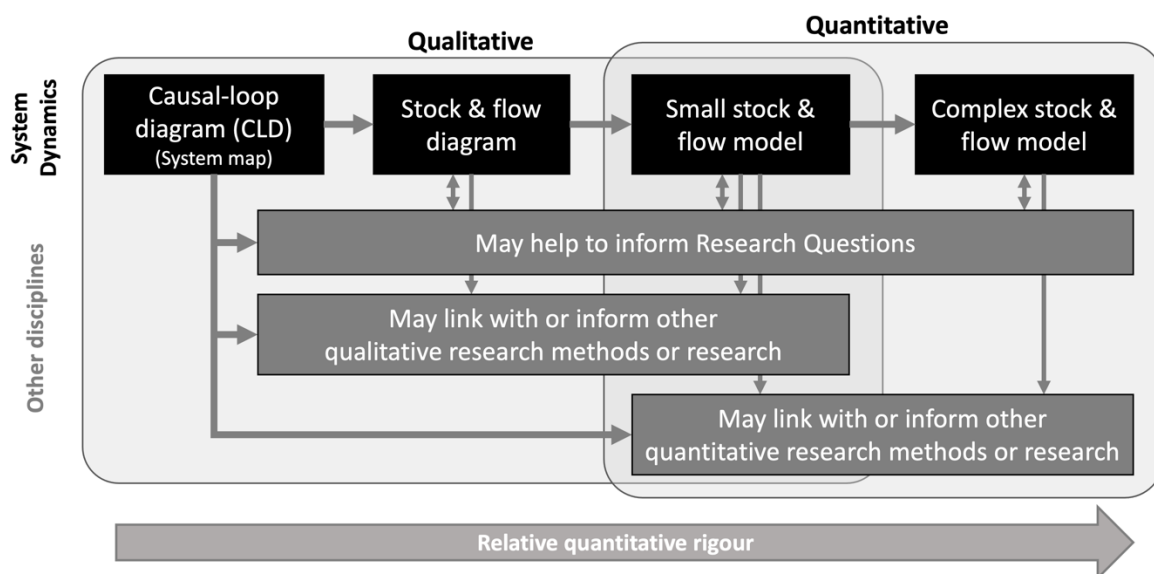
Note: There is an overlap of the qualitative and quantitative areas of application because they are not mutually exclusive. For example, some quantitative relationships in models and their calculations may be informed by research or data, while others may be informed or assumed via some form of participatory process.

The series of *black boxes* across the top of the diagram in Figure 36, represent the increasing quantitative rigour of the System Dynamics tools. The *grey boxes* in the lower part of the diagram, represent the research questions that may be generated in the course of research; as well as the different qualitative and quantitative methods that may be employed within the research. All of these may be informed by the causal loop mapping process, or a more rigourous evolution of a causal loop map (for example a small stock & flow model).

For example, a causal loop map may provide insight to the nature of the relationships of interest that may inform how a research question is framed. It may also inform the types of people who

SUSTAINABLE SEAS   86   Piloting the use of Systems Mapping in the Sustainable Seas
                                                                                                 National Science Challenge
                                                                                                 Te Ao Māori perspectives and Causal Loop Mapping Pilot

might be involved (as researchers or as research subjects). Further, the nature of the relationships elicited throughout the causal loop mapping process could also inform other research methods that may be used – either qualitative or quantitative.

Increasing up the rigour scale does not necessarily improve the insights of research. Our position here is that more precise numerical measures tend to give systems theorists the opportunity to specify more precise relationships and thus add layers of quantitative rigour to their models. Yet in complex worlds, qualitative methods are more likely to capture complexity and make it available for a wider range of analysis. In complex worlds, systems thinking and causal mapping may be used as a decision-support tool that enables a more holistic view of inter-relationships that may otherwise be missed or excluded from reductionist analyses (Senge, 2006).

Appendix 2   Overview of intended process

Summary:

- *Learning from the previous pilot, more time was taken to explain what causal loop mapping does and how it works*
- *A more adaptive approach to causal loop mapping was taken*
- *The decline of scallops was still intended as the focus of the causal loop map, to ensure consistency with the first pilot*
- *Māori have an intimate relationship with the natural world founded on Te Ao Māori worldview of the cosmology of the universe and all living things*

The initial systems mapping pilot found that insufficient time was spent on providing the context of how the causal loop map tool worked, and what the journey of the participatory process would follow. Consequently, these workshops were adapted to help with understanding the fundamentals of causal loop mapping.

No PowerPoint slides were used in the first workshop. The focus instead was on the discussion between participants and the use of analogies to describe the concepts of accumulation and feedback (see Appendix 1 for a more detailed description of these).

Further, the facilitator was prepared for a much more adaptive approach to the causal loop mapping workshops.
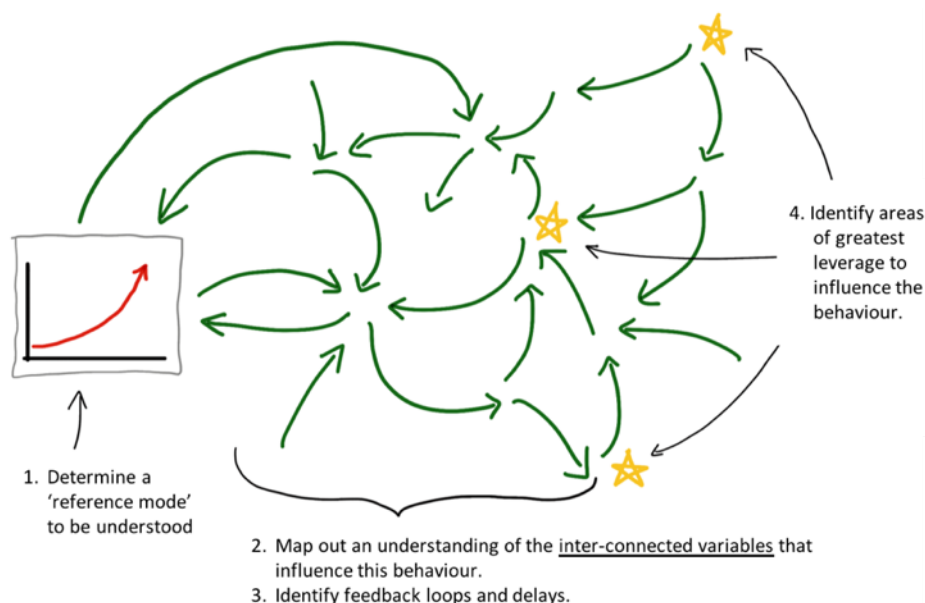
Overview of a causal loop mapping process

Causal loop mapping exercises are best directed by seeking to understand a problematic trend in some kind of variable of interest. This is best represented by a behaviour over time graph (a.k.a. a 'reference mode') rather than a static level of some kind of variable of interest. For example, "a declining level of….", or "an increasing concentration of…", or "a fluctuating level of [X], despite consistent levels of [Y]". This is important because a key objective of causal loop mapping is generating a *broad* understanding of how various influences interact to create the *dynamic* behaviour of interest.

An overview of the causal loop mapping process is as follows:

1. Determine/agree a reference mode ('behaviour over time' graph).

2. Working back from this point (as individuals or as a group in workshops) build up an understanding of the immediate influences of this behaviour, then the influences on those influences, etc.

3. Identify feedback loops and delays in this system structure. This builds a deeper understanding of the causes of these dynamics.

4. Use this understanding to identify potential *areas of leverage* within the network of causality – where can you intervene with the most leverage to improve the undesirable behaviour?

A conceptual example of what a causal loop map may look like is shown in Figure 37.

SUSTAINABLE SEAS   88   Piloting the use of Systems Mapping in the Sustainable Seas
                                                                 National Science Challenge
                                                                 Te Ao Māori perspectives and Causal Loop Mapping Pilot

Figure 37.   **Conceptual example of a causal loop map**

The focus issue – the decline of scallops

In order to enable the comparison of this causal loop map to that developed in the initial pilot, the issue of scallop decline was kept as the focus of this pilot. Scallops were chosen for several reasons: they were being studied in other parts of the challenge, so it was synergistic with this other work; and because scallops' habitat is the seabed, it was considered that focusing on scallops would provide much of the same insight as a focus on the seabed itself, which was also of interest to the challenge.

The stylised trend line of scallops decline that was used to focus the workshop conversations is shown in Figure 38[15].

Figure 38.   **Stylised trend line (behaviour of time) of scallop decline in Tasman/Golden Bays, for use in the workshops.**

The intended two-workshop process

---

[15] This stylised line was drawn of actual data points from graphs in Survey of scallops in SCA 7, January 2017: New Zealand Fisheries Assessment Report 2017/23 (Ministry for Primary Industries, 2017). For more detail on how this was determined refer to the original report (Deliberate, 2019).

SUSTAINABLE SEAS   89   Piloting the use of Systems Mapping in the Sustainable Seas
                                                                      National Science Challenge
                                                                      Te Ao Māori perspectives and Causal Loop Mapping Pilot

Causal loop mapping is a very iterative process and normally such workshops would be run over a whole day, with more than two in the series, depending on the complexity. The observations in this report should be read with the awareness that this was a shortened version of what would benefit from being a more comprehensive process.

The intended process was as follows:

Workshop 1:

1. Introduce participants to the concept of systems mapping using the bathtub analogy and describing feedback loops.

2. Discuss the scallop decline graph. Seek to expand this graph back in time according to a timeframe that was deemed appropriate

3. Elicit initial factors that they believed influenced the decline in scallops, over this extended timeframe.

Workshop 2:

1. Present the initial draft system map back to participants for discussion.

2. Make further refinements to the variables and influences as required.

3. Agree upon a draft causal loop map (as far as it is developed) as an output of this Māori workshops pilot, and discuss how this may/may not be a useful tool for articulating the whānau perspectives.

# Appendix 3   What is Ecosystem Based Management (EBM)

The purpose of the Sustainable Seas National Challenge is to address and resolve the growing conflict between New Zealand's many uses of the marine environment, including its marine economy and protection of the marine environment.

The Challenge Objective is: "To enhance utilisation of our marine resources within environmental and biological constraints" and the Mission is: "To transform 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".

Ecosystem based management (EBM) is an holistic approach to managing marine ecosystems, recognising that marine ecosystems are highly complex and made up of many interdependent parts, including humans. While this is being used elsewhere in the world it has not yet been applied in Aotearoa New Zealand (post-European contact).

To help navigate the approach to EBM, the Challenge developed a definition and seven principles for ecosystem-based management - EBM for Aotearoa New Zealand (with input from Māori and stakeholders (see Figure 39). This has been used by the Challenge to help guide its approach to EBM.

Figure 39.   Principles for Aotearoa New Zealand ecosystem-based management (source: Sustainable Seas National Science Challenge).
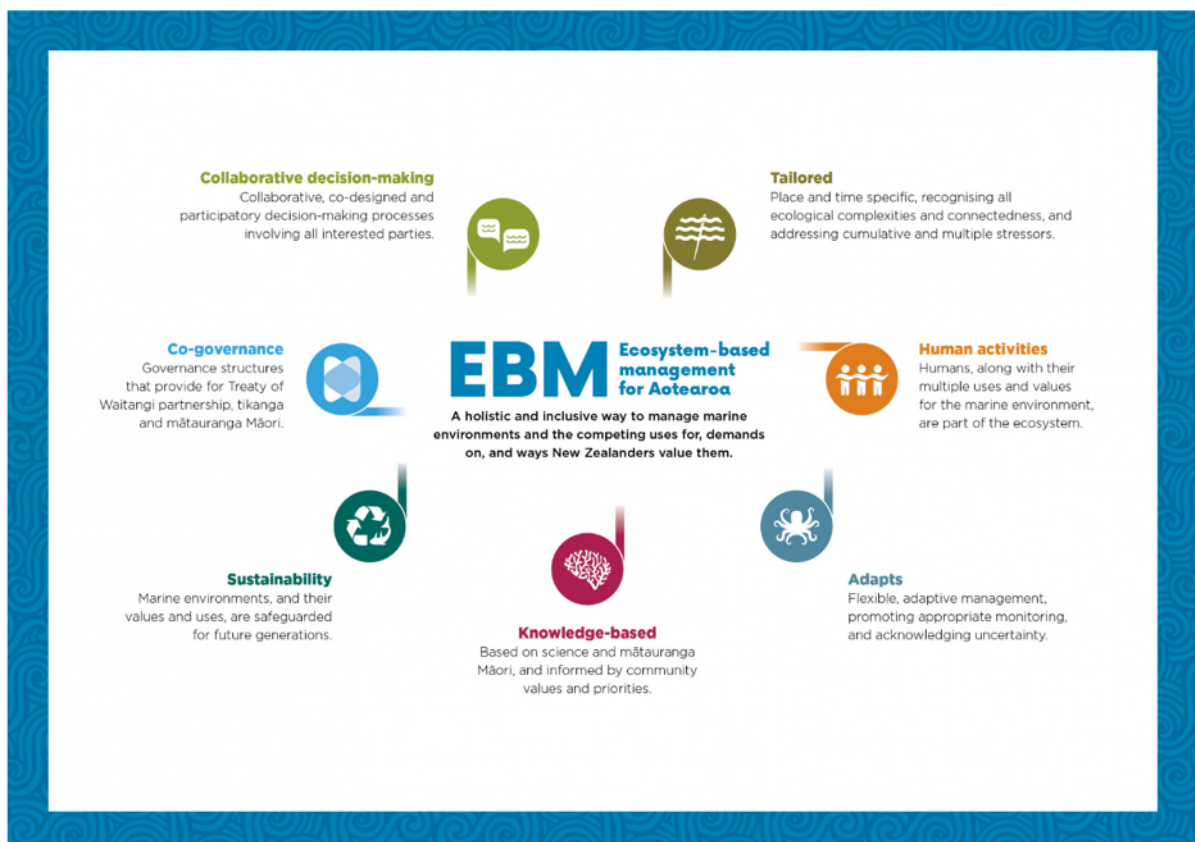
Appendix 4   Overview of iwi engagement and participation in Crown and Council processes, structures and systems

Section 13 'Te Ao Māori and Eurocentric systems management' this is not the right title, but reflection on what happened in August 2019 board work – if this tool doesn't support us to uphold/support/nurture etc our rights, values, interests to "do the do" then what's the point?

At the first workshop, it was important for one of the participants to provide an overview on the whiteboard of the various Crown and council structures, systems and processes iwi were engaged in to share with the facilitator.
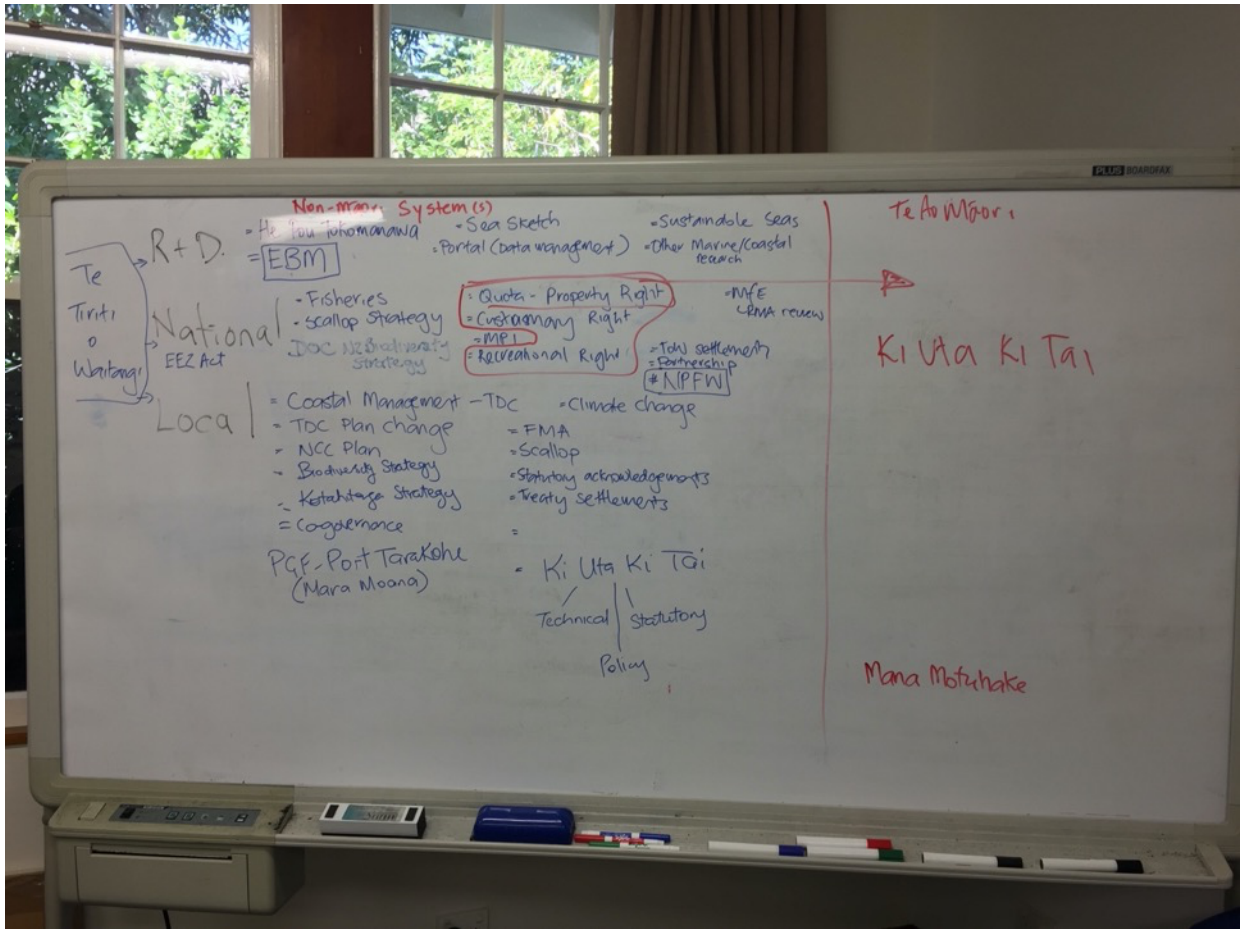
This was to:

a) provide an iwi context of kaitiakitanga undertaken by participants to assist Crown and councils to make decisions, perform functions and exercise powers by promoting te ao Māori values and interests and its application and relevance to guide decision making to ensure the health and wellbeing of the natural world including the marine environment and taonga species in Te Tai-o-Aorere ki Mohua;

    i.   to demonstrate the lack of coordination and integration of Crown, Council and consequent research structures, systems and processes, in the management of the natural environment.

    ii.   highlight the frustration and fatigue of Iwi to constantly participate in inadequate structures, systems and processes that fail to give effect to Te Tiriti o Waitangi and failure of Crown and councils to act in accordance with statutory provisions referring to the Treaty of Waitangi;

    iii.   enable shared understanding of the importance for this pilot project to enhance and assist Iwi advocacy role with the various agencies to deliver positive nett restorative environmental outcomes

The whiteboard notes from this discussion are shown below. Once the facilitator and participants shared kōrero about each other's work, participants decided they were willing to continue to explore the causal loop methodology.

Figure 40.   Whiteboard notes detailing the number of 'systems' Iwi are involved with

93

Piloting the use of Systems Mapping in the Sustainable Seas
National Science Challenge
Te Ao Māori perspectives and Causal Loop Mapping Pilot

Appendix 5   Ngā Atua o Te Ao Māori

Ngā Atua o Te Ao Māori – some of the Gods of Te Ao Māori.

- Ranginui - sky father;

- Papatūānuku - earth mother;

- Tāne-mahuta – guardian of forests and birdlife;

- Tangaroa – guardian of oceans, rivers, waterways, fish;

- Tāwhiri-mātea – guardian of winds, air and clouds;

- Tūmatauenga – guardian of war and people;

- Rongo-mā-Tāne – guardian of peace and cultivated foods;

- Tū-te-wehiwehi – guardian of repitles, and amphibians; and

- Haumia-tiketike – guardian of uncultivated foods and fern roots.

Appendix 6   Te Tauihu post-settlement treaty entities

The following eight iwi authorities represent and exercise Mana Whenua and Mana Moana across Te Tauihu rohe, respectively:

(i). Ngāti Apa ki Te Rā Tō Trust;

(ii). Ngāti Koata Trust;

(iii). Ngāti Kuia Trust;

(iv). Te Rūnanga o Ngāti Rārua;

(v). Ngāti Tama ki Te Waipounamu Trust;

(vi). Te Atiawa Manawhenua Ki Te TauihuTrust;

(vii). Te Rūnanga a Rangitāne o Wairau Trust; and

(viii). Te Rūnanga o Toa Rangatira.

Te Tauihu Statutory Acknowledgements (2014) document outlines the cultural, spiritual, historical, and traditional relationship of iwi and the once thriving freshwater and coastal fisheries that whānau, and hapū exercised tino rangatiratanga, kaitiakitanga and manaakitanga. The document also outlines the eventual degradation and depletion of taonga species due to extensive and intensive land development activities without regard to the protection of Māori rights and interests to whenua, moana and ngā taonga tuku iho including exclusion of Māori participation in governance and management processes and practices. It is therefore important to whānau that they are empowered, enabled, respected and recognised for reaching Treaty settlements with the Crown and recognised by Crown and council agencies of the importance of these Treaty settlements and the role of agencies in fulfilling Treaty settlements aspirations.

SUSTAINABLE SEAS   95   Piloting the use of Systems Mapping in the Sustainable Seas
                                                National Science Challenge
                                                Te Ao Māori perspectives and Causal Loop Mapping Pilot

Appendix 7 System map from the first systems mapping pilot

The below is the systems map developed from an institutional (i.e. participants were from a Crown agency, council of research institute) and/or science knowledge perspective in the first part of this pilot (See Deliberate (2019)).