National SCIENCE Challenges

SUSTAINABLE SEAS

Ko ngā moana whakauka

MAUNGAHARURU TANGITŪ

He Kāinga Taurikura o Tangitū

Ko Ngā Moana Whakauka
Tangaroa
He Kāinga Taurikura o Tangitū
Maungaharuru-Tangitū, 2024

Sustainable Seas National Science Challenge
Tangaroa Programme, Project T5
He Kāinga Taurikura o Tangitū: Treasured Coastal Environment
Maungaharuru-Tangitū Charitable Trust, 2024

Prepared by:
Hayley Lawrence (Kaikirimana Taiao, Maungaharuru-Tangitū Trust)
Kelly May (Marangatūhetaua; Marine Scientist, Te Kūwaha, NIWA)

Contributors:
Kāhui Kaumātua including Bevan Taylor, Matiu Eru, Trevor Taurima
Justin Puna
Te Tumu Tangitū including Carl Cotter, Rhodes Kihi-Apuwai, Whetumārama Kire, Nevada Nathan, Dayna Peterson, Nani Taane, Cliff Tarau, Joeseph Taurima, Robin Taurima, Joe Tawhai, Rangi Tawhai, Coralee Thompson
Manu Tāiko including Deane King-Peters, Kevin Rollinson, Tana Peterson
Other kaitiaki including Perēri King, Marewa Reti, Heeni Taane, Hoani Taurima

NIWA including Leigh Tait, Rachel Hale, Henry Lane, Stephanie Mangan, Tekiteora Rolleston-Gabel, Louis Olsen, Jon Stead, Stuart Mackay.
Emilee D. Benjamin (University of Auckland).

For any information regarding this report please contact:

Kelly May
Maungaharuru-Tangitū Trust
PO Box 3376
Hawke's Bay Mail Centre
Napier 4142

kelly.may@tangoio.maori.nz

Mihimihi

Kei ngā whakatamarahi ki te rangi, kei ngā whakateitei ki te whenua, tēnā koutou katoa.

Me mihi ki ō tātau mate, ko rātau ngā kaiwhakakōrero i ngā pakitara o tō tātau whare whakairo i ngā kihi maitai hoki o Tangitū.

Haere atu koutou.

Hoki atu ki te pūtahitanga o te kōrero, ki te huihuinga o te huatau.

Waiho mai mātau, ko ngā whakareanga o muri mai.

Kua raru tō tātau ao, tō tātau oranga i ngā āhuatanga o te wā.

Kua tīngakungakutia te whenua, te moana, te marae, ngā kāinga.

Heoi, ka whaiwhairoroa tātau, ka manawa tītī tonu tātau kia kumanungia tātau, kia whakautengia Te Taiao e tātau anō nā te mea e kore rawa e mutu te pānga mai o ngā āhuatanga hurihuri.

Ko tā tātau he āta whakarite i a tātau anō kia iti iho ngā pānga kino o āpōpō atu, ki te kore ko tātau me ā tātau mokopuna te papa.

Mā tini mā mano ka rapa te whai.

Ko Maungaharuru te maunga,

Ko Tangitū te moana,

Ko Tangoio te marae,

Ko Punanga Te Wao te whare tipuna,

Ko Tangitū te whare kai,

Ko Maungaharuru te whare kōkiri,

Ko Punanga Te Wao te kōhanga reo,

Ko Marangatūhetaua, Ngāti Whakaari, Ngāi Tauira, Ngāti Kurumōkihi, Ngāi Te Ruruku ki Tangoio, Ngāi Tahu ngā Hapū.

Tēnā anō tātau i roto i ngā whakaaro matihere o te wā.

Toitū te whenua, Toitū te moana, Toitū te tangata.

Rārangi Upoko – Contents

Whakarāpopoto – Summary

Haere ki ngā wāhi taonga, kia ako, kia rongo,
i te wairua, i ngā tohu o Te Taiao,
arā, i ngā kihi maitai.

(Go to wāhi taonga to learn, connect to atua, to feel, sense, the signs of Te Taiao, the murmurings of the moana.)

Our kaumātua and pakeke generously shared their mātauranga tuku iho, alongside younger kairuku and kaitiaki of our Hapū. The authors had the privilege of bringing their knowledge together. Sadly, numerous kaumātua who supported this kaupapa have passed away. They were invaluable repositories of mātauranga tuku iho. Their absence is deeply felt and highlights the urgent need to carry forward their legacy.

Ko rātau kua whetūrangitia haere atu rā.
Hoki mai ki a tātau te hunga ora e mahi tonu ana kia tutuki ngā wawata.

Ko Ngā Moana Whakauka – Sustainable Seas

This project is part of Ko Ngā Moana Whakauka Sustainable Seas Science Challenge (SS), whose vision is "that Aotearoa New Zealand has healthy marine ecosystems that provide value for all New Zealanders" (SS 2024). The research involved in the Challenge addresses the question:
"How can we best develop our marine economy, while protecting the taonga of our marine environment?" and "focuses on:

1. Improving marine resource decision-making and the health of our seas through Ecosystem Based Management (EBM)
2. Transforming New Zealand's ability to enhance our marine economy into a blue economy".

This research is a Phase II project funded by the Tangaroa programme, that **"places Māori at its centre, and aims to promote and support Māori-led or partnered projects to enable direct benefits to those iwi and hapū involved"** (SS 2024).

This report outlines our journey and presents recommendations from He Kāinga Taurikura o Tangitū (Treasured Coastal Environment project). It is designed for the hapū represented by Maungaharuru-Tangitū Trust (the Hapū) and other hapū and iwi. The methodology is underpinned by Kaupapa Māori research principles and aims to share perspectives and enhance understanding of the Hapū connection to Tangitū (moana in Te Matau-a-Māui – Hawke's Bay), mahinga kai (Kuku Reef) and kaimoana (kuku).

Te Taiao is central to the Hapū identity and cultural wellbeing. This project upholds kaitiakitanga, within which Te Tiriti and contemporary environmental management (including Ecosystem Based Management) are placed. It embodies mātauranga tuku iho, and the conceptualisation of He Kāinga Taurikura- our cultural-environmental framework grounded in a Hapū whakatauākī and Marae waharoa. This framework exemplifies our diverse interrelationships with Te Taiao as tangata whenua.

Additionally, this report aims to enhance understanding of the Hapū relationship with Tangitū among local and central government agencies, as well as community groups involved in environmental management within Te Matau-a-Māui. The Hapū advisory group, Te Tumu Tangitū, considered science-based approaches to broaden our understanding of Tangitū, Kuku Reef and kuku. It is important to build and strengthen capacity and capability in all forms, fostering different ways of knowing, to better enable collaborative efforts for a unified approach to improving the health of Tangitū (moana) and Te Taiao.

Our Research Phases

He Kāinga Taurikura o Tangitū research contract comprises four key phases:

1. **Cultural Environmental Assessment Framework:** He Kāinga Taurikura is a framework conceptualised to guide and communicate the Hapū assessment of environmental taonga, ensuring its relevance and applicability into the future.
2. **Wānanga:** Wānanga facilitated knowledge sharing among kaumātua, pakeke, kairuku and kaitiaki of our Hapū to share mātauranga tuku iho, describe the current state, pressures and goals for Tangitū, Kuku Reef, and kuku. One of these wānanga introduced Hapū members to various science tools, methods and technologies, such as underwater drones (Remotely Operated Vehicles, ROV) and environmental DNA (eDNA)).
3. **Application of science-based tools, methods and technologies:** A pilot field study was completed, and ecosystem data analysed to develop seafloor maps (visualised via Story Map at tangoio.maori.nz/kukustorymap) and inform the development of a Hapū Implementation Plan and an i-Pou Concept Design Plan, particularly in the context of ongoing impacts and restoration efforts following Cyclone Gabrielle in February 2023.
4. **Final report**: This is the final report on all phases of the research project for Maungaharuru-Tangitū Trust (MTT).

To help our Hapū understand the significance of this project as a foundation for current and future actions and decision making, our approach in its simplest form was to:

- conceptualise He Kāinga Taurikura (Cultural Environmental Assessment Framework) and Hapū survey tools – Ngā Arotake – to reinvigorate mātauranga tuku iho and tikanga practices to assess hauora of Tangitū, Kuku Reef and kuku. The tools are one way to assist us as active kaitiaki.
- collaborate with NIWA to consider science-based approaches for a pilot field study aimed at broadening our understanding of Tangitū, Kuku Reef, and kuku.
- present ecosystem quantitative data at scales that are culturally relevant.

MTT sets the strategic direction and annual operating plan to achieve the vision, aspirations and goals of our Hapū. Cyclone Gabrielle continues to pose significant challenges impacting our Marae and Hapū wellbeing, capability, and capacity. The implementation of initiatives under He Kāinga Taurikura o Tangitū will rely on their integration into these plans.

It is also important to emphasise that Crown agencies, local councils including the Hawke's Bay Regional Council, need to be aware of our priorities and recommendations. Partnerships and collaboration are essential for addressing these priorities and ensuring the betterment of Te Taiao.

Recommendations

The following recommendations aim to reinvigorate mātauranga tuku iho, build capability and capacity, and enhance monitoring efforts to support and improve the health of Tangitū.

Based on the project's findings, we recommend the following four priorities:

1. Reinvigorate mātauranga tuku iho and cultural values
2. Strengthen relationships and enhance resourcing for building Hapū capability and capacity
3. Address sedimentation and erosion
4. Complement tohu monitoring with science data for a broader understanding.

1. Reinvigorate mātauranga tuku iho and cultural values

- Strengthen connections between tangata whenua and Te Taiao that promote balance between people and the environment.
- Embed the importance of whakapapa, mana, tino rangatiratanga, tauutuutu, kaitiakitanga and other core values of the Hapū in environmental practices and policies.
- Embed He Kāinga Taurikura (Cultural Environmental Assessment Framework) and progress:
    - Implementing Ngā Arotake, tohu monitoring by tangata whenua, to monitor and detect changes in the hauora of taonga, i.e. Tangitū, Kuku Reef, and kuku. For instance, our tīpuna and kaitiaki observe flowering plants to gauge the readiness of different kaimoana (when the season of Tangitū is open); or track bird presence and behaviour, such as the feeding habits of kererū (when the season of Tangitū is closed).
    - Developing the Hauora Visualisation Tool, to effectively communicate hauora assessments informed by tohu monitoring, indicating trends over time.
- Advocate for decision making processes that respect mātauranga tuku iho including our cultural-environmental scales.
- Maintain control over the use and sharing of mātauranga tuku iho in alignment with the principles of Te Mana Raraunga (2018), ensuring that data sovereignty and the protection of Māori data are prioritised throughout the process.
- Install an i-Pou as a communication tool to promote appreciation and awareness.

2. Address sedimentation and erosion

- Strengthen and advocate for actions and policies that protect and restore Tangitū (te moana) and Maungaharuru (te whenua).
- Implement actions to prevent further soil dislodgement and to capture and settle soil particles that have already been eroded.
- Consider defining restoration goal(s) and a plan for implementing restoration using biogenic methods, such as establishing natural structures within Tangitū to enhance habitat for our kuku and mitigate sedimentation impacts.

3. Strengthen relationships and enhance resourcing for building Hapū capability and capacity

- Strengthen relationships to foster the delivery of actions that provide tangible benefits to Te Taiao.
- Advocate for equitable Crown and council resource distribution to support Hapū kaitiakitanga initiatives.

4. Complement tohu monitoring with science data for a broader understanding

Consider employing science methods that are accessible for the Hapū and collaborate with relevant agencies to:

- develop a program alongside the tohu monitoring led by kairuku (Hapū divers) to collect kuku safely and prepare samples for analysis to assess their condition, histology and contamination levels, particularly faecal coliform bacteria / *E. coli* (i.e. collecting samples and implementing standardised condition assessments and / or sending samples for analysis, at a cost).
- develop tools such as dashboards that make quantitative data (e.g. state of the environment monitoring data) available, relevant and understandable to the Hapū at cultural-environmental scales that are aligned with our whakatauākī seasons and maramataka phases.
- utilise satellite data to monitor water quality indicators for Tangitū, in combination with other monitoring methods like kuku condition analysis and tohu monitoring

Note: the design, collection, analysis, and reporting of quantitative science data are costly and may require long-term collaboration, effort and expertise. While eDNA methods show considerable promise for marine coastal monitoring, like other methods they have limitations and require specialist skills. As eDNA and other science methods advance, reconsider their accessibility and effectiveness alongside our tohu monitoring.

In February 2023, Cyclone Gabrielle devastated our region, causing severe damage and pollution to the land and sea within our takiwā (traditional area). At Tangoio, the only marae of our Hapū, and the papakāinga were destroyed. Lands at Tangoio, Pākuratahi, Arapawanui and Te Waiohingānga (Esk) are now classified as Category 3, indicating that there is an intolerable risk to life from future severe flood events, as defined by the Government and the Hawke's Bay Regional Council. As a result, these areas are considered unsafe for residential occupation.

The devastation caused by Cyclone Gabrielle forced our Hapū and MTT to reassess and refocus our efforts beyond this project. MTT had to allocate its limited capacity and resources towards emergency response and ongoing recovery efforts, resulting in a delay in project completion.

We are thankful to Ko Ngā Moana Whakauka – Sustainable Seas National Science Challenge and Te Kūwaha – NIWA for their support.
Tēnei ka mihi ki a koutou.

Our Hapū Worldview

He Kāinga Taurikura o Tangitū is firmly rooted in, and privlleges the Hapū worldview. It draws on mātauranga tuku iho of kaumātua and whānau, as well as the experiences of the authors. This approach aims to uphold kaitiakitanga and asserts that Tangitū (moana) encompasses cultural-environmental scales that embody diverse dimensions of whakapapa relationships.

There are many deep layers of mātauranga tuku iho, and our overview does not describe its full depth and breadth, nor is it the only way it should be described. We have prioritised wānanga and written kōrero, and it is in this light that we present our report.

Report Structure

The following sections of He Kāinga Taurikura o Tangitū outline:

Our Hapū Worldview

Research Phases:

- Phase 1: Cultural Environmental Assessment Framework – He Kāinga Taurikura
- Phase 2: Wānanga learnings
- Whāinga- Goals
  - Summary of Goals and Perspectives
  - Mātauranga tuku iho and cultural values are reinvigorated
  - Karakia
- Using mātauranga tuku iho to assess hauora
  - Ngā Arotake – Survey Tools
  - Hauora Visualisation Tool
- Phase 3:
  - Setting the scene
  - Identify and apply different science-based approaches
- Recommendations –
  He Kāinga Taurikura
  Hapū Implementation Plan

Te Pao

Nā Justin Puna i tito

Composed by Justin Puna

Tū ana te kārearea i te keokeonga o
Tarapōnui-a-Kawhea

Ka titiro iho ia ki Tītī-a-Okura ki te wāhi ko Tauwhare Papauma e

I titia ai e tō Tūpai tokotoko i mau ai te mauri o te manu

Haruru ana te maunga rā

Rere ana te kārearea,

ka titro whakatau iho ia ki nga awa

Waikare, Waitaha, Anaura e ahu mai nei i te mātāpuna kai Maungaharuru e

Puta atu ana te wai o Waikare i Te Puta a Hinetonga ki Ōmoko

Pātōtō ki te ata, pātōtō ki te pō

Ka rere whakatetonga, kite iho ana i a Waiohingānga

Tahuri atu rā ki te rāwhiti ki
Te Ngarue, *he tipua, he taniwha*

Tahuri mai ana ki nga roto

Te Pōhue, Opouahi he wāhi tapu, he roto tuna

Orākai, Waikōpiro ko nga kanohi o Tūtira e

Tūtira *he pātaka kai, oranga ngākau, oranga tangata*

Kotahi atu ia ki nga tai o

Moeangiangi, Arapawanui, Waipātiki, Punakērua, Tangoio,

Tangitū *he tohorā he kaitiaki e*

Kite iho i nga toka Ōmoko Urukaraka, Whakapao, Ngaio-iti,

Whakatapatu, Kōtuku, Hinepare, Makaro, Te Ahuaruhe, Pānia e

Tau atu ana ia ki

Punanga Te Wao, te whakairinga o te kupu, te whakapiringa o te tangata o

Marangatūhetaua, Kurumōkihi, Te Ruruku, Ngai Tauira e

Hoki atu ana te kārearea

e hia kē nga pā kua kitea

Ko tō rātau pā kai nga rekereke

Maungaharuru ki Tangitū, Keteketerau ki Waikare

Ka kati a Maungaharuru, ka tuwhera a Tangitū

Ka kati a Tangitū, ka tuwhera a Maungaharuru e

The kārearea stands upon the highest point/top of Tarapōnui-a-Kawhea

and gazes upon the place aptly named Tītī-a-Okura to the area of Tauwhare Papauma.

The place where Tūpai pierced his stick, which held the life force of birds

and the mountain reverberated

The kārearea takes flight, looking with intent upon the tributaries of Waikare, Waitaha and Anaura whose headwaters are in Maungaharuru.

The waters of Waikare flow out through the river mouth Te Puta a Hinetonga on to the Omoko reef, whence our proverbial saying

pātōtō ki te ata, pātōtō ki te pō.

Taking flight southwards, he sets his eyes upon the Waiohingānga, turning to the east he observes

Te Ngarue, *a denizen, a custodian.*

Now it focuses its attention on the lakes Te Pōhue, Opouahi a most hallowed place, a lake profuse with tuna,

Orākai and Waikōpiro, the eyes of Tūtira

Tūtira, *a place of sustenance, well-being, life.*

He now heads straight for the shores of Moeangiangi, Arapawanui, Waipātiki, Punakērua, Tangoio,

Tangitū *a whale, a guardian*

He looks below and surveys the reefs of Ōmoko Urukaraka, Whakapao, Ngaio-iti, Whakatapatu, Kōtuku, Hinepare, Makaro, Te Ahuaruhe, Pānia

He now settles on Punanga Te Wao, the place where our history is held, where the progenies of *Marangatūhetaua, Kurumōkihi, Te Ruruku and Ngai Tauira* congregate

Copious amounts of pā have been spotted, whence the saying,

'Their pā were in their heels' comes from

From the great mountain Maungaharuru to the shoreline of Tangitū, from Keteketerau to the

pristine waters of Waikare we call home

When the season upon Maungaharuru closes, Tangitū welcomes us

When the season Tangitū comes to a conclusion, Maungaharuru welcomes us.

Artwork by Rakai Karaitiana

Whakatauākī

Ka tuwhera a Tangitū, ka kati a Maungaharuru

Ka tuwhera a Maungaharuru, ka kati a Tangitū

When the season of Tangitū opens, the season of Maungaharuru closes,

When the season of Maungaharuru closes, the season of Tangitū opens

This whakatauākī:

- describes the takiwā of our Hapū – from Maungaharuru in the west, to Tangitū (the sea) in the east; and
- proclaims ahi-kā-roa of our Hapū and our inherited right as tangata whenua to exercise mana whenua and mana moana.

The relationship our Hapū have with Tangitū is culturally significant and provides whānau with a strong sense of place and belonging to our takiwā. It is still customary practice for Hapū members to recite this whakatauākī to identify where we come from and the relationship that connects us to the natural world.

Hapū kaumātua also emphasise the connectedness of Maungaharuru with Tangitū. The waters flowing from the maunga feed the streams, rivers, aquifers, lakes, wetlands and sea – the realm of Tangaroa.

The whakatauākī also describes the mahinga kai of our Hapū. The ngahere on Maungaharuru was the source of food for the Hapū in winter. Tangitū was, and remains, a vital source of food in summer. While the Hapū collected kai on a seasonal basis, they were blessed in that they did not need to leave their takiwā in search of food. Hence another Hapū whakatauākī:

ko tō rātau pā kai ngā rekereke

their pā were in their heels

Tangitū provides:

- kai – ika, tuna, īnanga and ngaore (forms of whitebait), kōura, kuku, kina and pāua,
- rongoā such as kaiō (sea tulip) and sea water,
- other resources including tāwhaowhao (driftwood), pungapunga (pumice) and rimurimu (seaweed / kelp).

Tangitū was also integral to the economy of the Hapū as kai and other resources gathered from Tangitū were often traded with our neighbours.

The whakatauākī also implies that manuhiri will be served kai from Maungaharuru and Tangitū. The ability to offer the range and quality of kai from our takiwā enhanced our mana. Whenever possible, these important cultural practices continue today.

In addition, the gathering of kai and resources has the reciprocal obligation of our Hapū to be kaitiaki. Our tīpuna had tohu and tikanga which dictated the appropriate time and practices for gathering food and resources from Tangitū.

Mātauranga associated with the collection of resources was central to the lives of our tīpuna and remains a significant part of our Hapū cultural identity today. Mātauranga and associated tikanga, karakia and kawa are all essential for maintaining our customary traditions.

Atua

Papatūānuku

Papatūānuku is our earth mother, who supports us both on land and under the sea. She is a whole and indivisible entity. Papatūānuku is depicted in this drawing by Hapū artist Marewa King, surrounded by Tangaroa. The lines cascading down Papatūānuku's body is the water trickling down, from land to sea.

Ranginui

Ranginui, our sky father, is an integral and inseparable entity. He encompasses the heavens, providing the air we breathe and the rain that sustains our environment. His presence represents the celestial balance and vital life-giving elements between sky and land.

Tangaroa

Tangitū (the sea within our takiwā) is within the domain of Tangaroa-i-te-Rupetu. Tangaroa is the spiritual guardian of the moana, waterbodies, and all within them. Our Hapū are connected by whakapapa to the descendants of Tangaroa including whales, waves, ocean currents and fish life. Tangaroa is a whole and indivisible entity including the moana, coastal waters, beds, rocks, reefs and beaches, springs, streams, rivers, swamps, estuaries, wetlands, flood plains, aquifers, aquatic life, vegetation and coastal forests. Therefore the domain of Tangaroa goes from the tihi tapu (sacred peaks) of Maungaharuru to Tangitū – ki uta ki tai – from mountain to sea.

Hinemoana

Hinemoana is the female side of the moana. There is balance between the male and female. Hinemoana is nurturing, like our māmā. (Puna 2022).

Artwork by Marewa King

Whakapapa

Tō Mātau Whakapapa ki a Tangaroa

He hononga tā te Māori ki ngā mea katoa, ki te whenua, ki te moana.

Ki a mātau ngā Hapū, ko tō mātau hononga ki te moana,

tīmata mai i te atua o te moana,

ko Tangaroa-i-te-Rupetu.

Nā Tangaroa-i-te-Rupetu ko Ruamano, ko te tohorā he kaitiaki i ārahi, i whakatere hoki i te waka Tākitimu i tana rerenga ki Aotearoa

ā ka heke ka heke ki a Pānia,

nā Pānia ko Moremore,

ā ka heke ka heke ki a Tūnuiarangi.

He tangata a Tūnuiarangi, he rangatira, he tino tohunga ā he nui hoki tōna mana.

Ko ia tētahi o ngā tino tīpuna o tētahi Hapū ō mātau, ko Ngāi Tauira.

Nā reira tō mātau hononga ki te moana.

Ko ngā tūtohu whenua, ko te moana, he tīpuna ki a mātau.

Nā reira ko tā mātau ki ō mātau tīpuna he tiaki, he kumanu, he tuarā.

As Māori, we connect to everything in the natural world, including land and sea.

Our Hapū connect with the moana through whakapapa.

It starts with the god of the sea,

Tangaroa-i-te-Rupetu,

who begat Ruamano, the guardian whale that led and navigated the waka Tākitimu on its voyage to Aotearoa

and generations later Pānia was born,

who then had her son Moremore,

and eventually Tūnuiarangi was born.

Tūnuiarangi was a person, a rangatira, a tohunga of immeasurable power.

He is a key tipuna of Ngāi Tauira, one of our Hapū.

This is how we connect to the sea.

Land and sea are considered to be our ancestors.

We take care of, foster, nuture, support our ancestors.

Tō Te Mātaitai Whakapapa ki a Hinemoana

E ai ki etokohinu, nā Hinemoana ko ngā mātaitai, ā, ko Hinemoana te mokopuna a Tāne (Best 1982).

Ko ngā uri a Hinemoana, ko ngā rimu.
I noho piri ngā rimu ki a Rakahore rāua ko Tuamatua (arā ko ngā toka me ngā kohatu) hai tāwharau i ētahi uri a Hinemoana, ko ngā mātaitai.

Ko Hinekuku he uri nā Hinemoana.

Nā Hinekuku ko ngā kuku, ā,
nā tana tungāne Pāuatere ko ngā pāua.

Ina hiakai ngā tīpuna i te waka Tākitimu, ka karangatia a Hinekuku rāua ko Pāuatere.
Nā, ka piri atu ngā kuku me ngā pāua ki te taha o te waka hai kai mā rātau kai te waka (Turei 1996).

Nā Tāne ko tātau tonu ngā tāngata (Taylor 2016), nā konā tātau i hono atu ā-whakapapa ai ki te kuku.

According to some accounts, the whakapapa of mātaitai (shellfish) goes back to Hinemoana, granddaughter of Tāne (Best 1982).

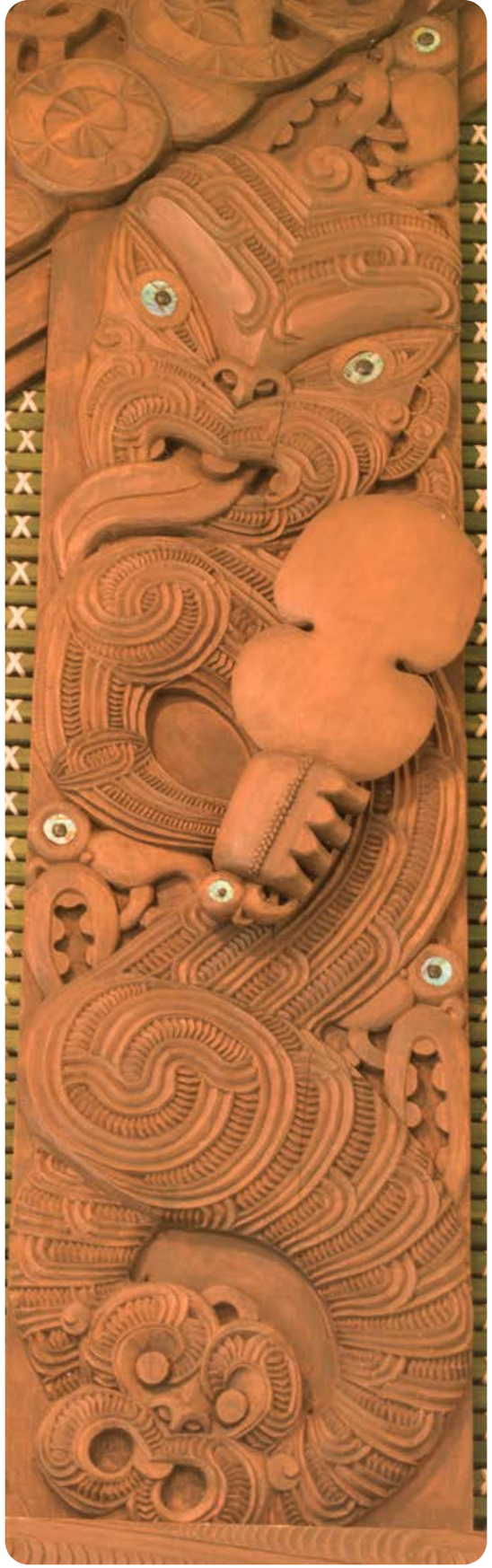
Hinemoana's offspring include seaweeds. They were attached to Rakahore and Tuamatua (who represent rocks and stones) to provide shelter for Hinemoana's other descendants, the shellfish.

Hinekuku is a descendant of Hinemoana.

She represents kuku,
while her brother Pāuatere represents pāua.

When the tīpuna on the waka Tākitimu were hungry they called to Hinekuku and Pāuatere. Kuku and pāua climbed up and clung onto the side of the waka, to feed those on board (Turei 1996).

As tāngata we too are descendants of Tāne (Taylor 2016) and are therefore connected through whakapapa to kuku.



Ruawharo

Ruawharo was a tohunga aboard the waka Tākitimu on its migration to Aotearoa.

He gathered sands from Hawaiki and took them on the waka.

The sands held the mauri of fishlife.

Ruawharo and his wife Hine-Wairakaia had three sons; Matiu, Makaro and Moko-tu-a-raro.

To extend the mauri of fishlife, Ruawharo placed his children along the coast at Waikōkopu in Te Māhia and between Rangatira and Te Ngaruroro.

Significantly for our Hapū, Makaro was placed at Arapawanui to instil the mauri of fish and whales along the coastline.

Tangitū

Tīpuna recounted that our moana, Tangitū, is named after a strong-willed young woman from our takiwā.

Tangitū was an excellent diver and collector of kaimoana who could stay submerged for long periods of time.

Tangitū went diving into a hole from which she never returned.

Tangitū manifested herself as a whale and is an important kaitiaki for our Hapū.

According to tradition, if tikanga or kawa were not properly observed when gathering kaimoana or other resources, Tangitū the kaitiaki would appear.

Our Hapū believe that, as a kaitiaki, Tangitū has the power to protect her people, particularly in the event of natural disasters. She has been known to use her tail to unblock the mouth of Te Ngarue Stream and Pākuratahi Stream, or lie across the mouth as protection in the event of high seas.

This image of Tangitū was carved by Kaumātua Bevan Taylor. In her kete Tangitū holds a kuku, pāua, and whētiko.

Kaitiaki

Waikare

Uwha is a kaitiaki at Arapawanui, who takes the form of a tuna (eel) or wheke (octopus).

Uwha

Moremore

Pānia's son, often seen in the form of a mako (shark).

Moremore has the ability to transform himself into other sea creatures, such as a whai (manta ray) at Waipapa.

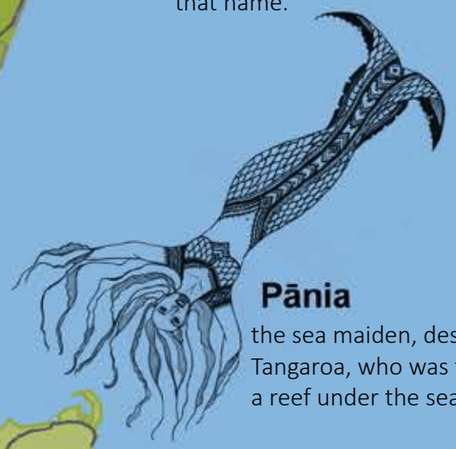
He is the kaitiaki for the coast of Te Matau-a-Māui and Tangitū.

Tangitū

Tangitū is the name of the rohe moana, and of a kaitiaki whale who looks after the Hapū.

Te Ngarue

A kaitiaki named Te Ngarue, taking the form of a tuna, lives in the awa (stream) of that name.



Pānia

the sea maiden, descendant of Tangaroa, who was turned into a reef under the sea off Napier.

Moremore

Ahuriri

Artwork by Marewa King

Takiwā

Map of the takiwā (traditional area) of our Hapū

Our takiwā extends ki uta to Maungaharuru and ki tai, to Tangitū (the moana); from Keteketerau in the south (the former outlet of Te Whanganui-ā-Orotu / Napier Inner Harbour) to Waitaha Stream in the north.

There are shared areas – south of Tangoio with neighbouring hapū and north of Waikari River with the descendants of Te Keu-o-te-rangi.

The map above shows some key place names and the names of the rivermouths along the coast.

Hapū

- Marangatūhetaua (also known as Ngāti Tū),
- Ngāti Kurumōkihi (formerly known as Ngāi Tatara),
- Ngāti Whakaari,
- Ngāi Tauira,
- Ngāi Te Ruruku (ki Tangoio), and
- Ngāi Tahu.

Marae

Our marae is Tangoio, located 20 km north of Napier.

Representative Body

We are represented by Maungaharuru-Tangitū Trust (MTT), and its charitable Trust entity – Maungaharuru-Tangitū Charitable Trust (MTCT).

MTT is a Treaty of Waitangi Post Settlement Governance Entity. Its core purpose is

Kia Tipu te Mauri Ora

(Growing Inner Strength)

to support the holistic growth of our Hapū – building the capability, capacity and tino rangatiratanga of our people, culture, environment, and economy.

MTT has over 6,500 registered members (as at 2024).

MAUNGAHARURU TANGITŪ

The tohu for Maungaharuru-Tangitū Trust and Tangoio Marae include a whale for Tangitū and black lines for Maungaharuru.

The name for our Trust is based on our whakatauākī.

The dash between the words Maungaharuru-Tangitū symbolises the link between the two – ki uta ki tai – from mountain to sea.

Toitū Te Tiriti

Te Tiriti o Waitangi Claim Settlement

The historical claims of the Hapū were pursued in different ways by our tīpuna for over 160 years. However, it was not until more recently, over the last 20 or more years, that those claims were finally heard before the Waitangi Tribunal and in negotiations with the Crown.

The Waitangi Tribunal (2004) upheld the claims of our Hapū and found that the Crown had breached the Treaty of Waitangi on many occasions causing suffering for our Hapū. The Crown also acknowledged the degradation of our taonga: our maunga, places of significance, lakes, rivers and coast, through the actions or inactions of the Crown.

Maungaharuru-Tangitū Trust signed a Deed of Settlement with the Crown in 2013 and the settlement was finalised with the passing of the Settlement Act in 2014. The settlement contains various forms of redress relating to our moana – Tangitū, for example:

- One form of cultural redress is through official recognition of the significance to our Hapū of areas that are owned by the Crown. This includes the coast, rocks and reefs and coastal marine area, rivers and their tributaries, lakes and reserves.
- The settlement includes redress which aims to improve the relationship of various Crown agencies and local authorities with our Hapū. The redress takes the form of agreements or membership of various committees.

  For example, it includes a fisheries relationship agreement in conjunction with Ngāti Kahungunu Iwi Incorporated and Te Kawenata – a partnership agreement with the Minister of Conservation that reconnects our Hapū to the governance of all areas of Conservation Land.
- Official recognition of traditional place names was part of the settlement and includes coastal names i.e. from south to north:

  Hinekatorangi Wetlands, Te Uku Bluff, Panepaoa, Ngāmoerangi, Pākuratahi Stream, Te Ngarue Stream, Te Areare, Whakaari, Punakērua Beach, Waipātiki Beach and Stream, Tiwhanui.

MTT represents the Hapū who hold and exercise rangatiratanga within the takiwā and have done so since before the arrival of the Crown. The Crown and Parliament have recognised the enduring nature of that rangatiratanga through:

- Article II of Te Tiriti;
- the Deed of Settlement in which the Crown recognises the Hapū as the tangata whenua of their takiwā; and
- the Settlement Act in which Parliament endorsed and implemented the Deed of Settlement.

As recorded in the Crown Apology to the Hapū (Maungaharuru-Tangitū Hapū et al. 2013), the Settlement marked a turning point, and the beginning of a "new relationship" between the Crown and Hapū based on respect for Te Tiriti. The Crown apologised for its "past wrongs toward the Hapū" and apologised for having "not always lived up to its Treaty of Waitangi obligations", and that it had "breached the Treaty of Waitangi, and its principles, in its dealings with the Hapū". Of particular relevance from the apology is the following:

"Through this settlement the Crown is seeking to atone for its past wrongs towards the Hapū, to restore its tarnished honour, and to begin the process of healing. The Crown hopes that this apology will mark the beginning of a new relationship between the Crown and the Hapū based on respect for the Treaty of Waitangi and its principles."

The expectation of MTT is that, regardless of the content of any specific legislation, the Crown acts consistently and at all times with that overarching pledge.

Photo (right): Tuku Whenua 2017
Our Hapū, Te Papa Atawhai (DOC), and friends celebrated the return of four Reserves to our Hapū as part of the Cultural Redress in our Treaty Settlement. (These reserves were later gifted back to the people of Aotearoa.) Commemorative plaques at each of the reserves, including Whakaari (pictured), acknowledge our Hapū as kaitiaki.

Pā

Naturally our Hapū had kāinga and pā all along the coast to enable them to access these superb fishing grounds and to defend them from raiding parties (Taylor 2020a).

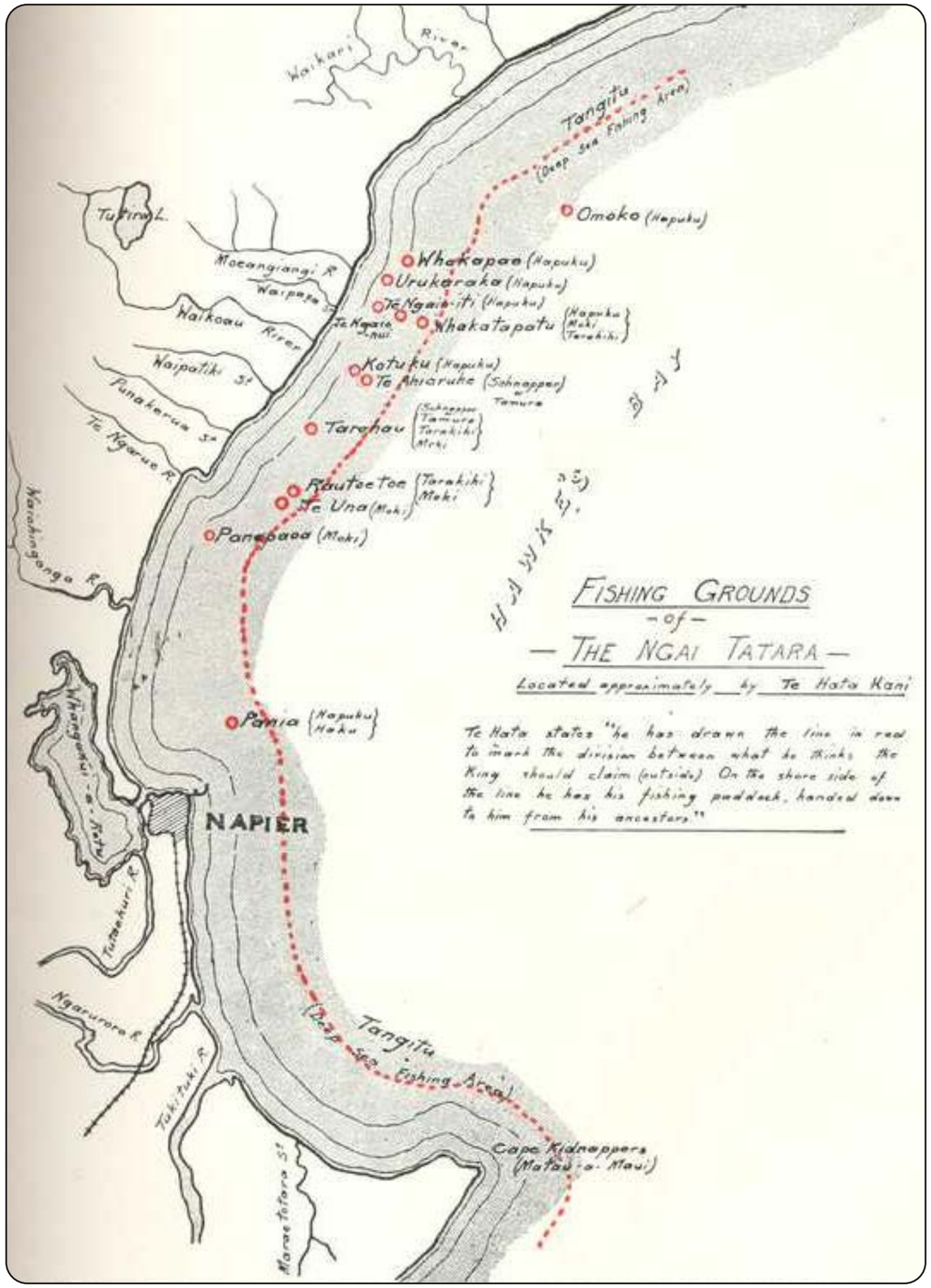
There were pā situated strategically around Tangoio, especially in the time of the eponymous tīpuna, Marangatūhetaua, Tataramoa and Te Ruruku for whom three of our Hapū were named.

Ngāmoerangi was a limestone outcrop where the present mouth of the streams Te Ngarue and Pākuratahi are situated. From that pā our people would prevent the waka taua (enemy war canoes) that came across the bay from landing. The pā also afforded protection of our southern and western flanks from invasion overland.

The fighting pā Whakaari overlooked and protected the landing sites for waka on the bays below and stood as a bastion on the northern and eastern flanks.

Situated in the middle and just behind these pā was the formidable fighting pā Te Rae-o-Tangoio.

Another noteable pā and kāinga near the awa is Te Rua-a-Tunuku. Te Ruruku and his people built and occupied this pā to keep guard over the surrounding area.



Mahinga Kai

In earlier times, our tīpuna made seasonal journeys to Tangitū to collect kai, rongoā and other natural materials.

Whānau and individuals had different tasks. Some would go fishing, while others would collect shellfish, or collect plant materials from the coastline and associated lowland forests.

Natural resources thrived, and kōrero tuku iho identify particular rocks and reefs as being renowned for providing bountiful kaimoana from which to gather a variety of fish species.

Tangitū teemed with fish including tarakihi, tāmure (snapper), herrings, hāpuku (grouper), blue moki, and mangō (shark), as well as tohorā (whales).

The coastal rocks and reefs provided pāua, kina, kuku, pūpū, kaiō (sea tulip) and kōura.

From the mouths of rivers and streams, pātiki (flounder), tuna, īnanga and ngaore (forms of whitebait) and kōkopu (a freshwater fish) were harvested.

Along the coast and nearby were significant mahinga kai

- The mouths of the Waikari, Moeangiangi, Arapawanui, Waipātiki River, Te Ngarue Stream and Pākuratahi Stream.
- Tiwhanui is identified by the Hapū as the highest place along the cliffs on the Coast. It was used by the Hapū as a lookout for whales and schools of fish on fishing expeditions.
- Punakērua and Te Areare beaches.

Map (left): Fishing Grounds of The Ngāi Tatara (Guthrie-Smith 1926)

- The Rocks and Reefs that were renowned for kaimoana are:
  - **Omoko:** located out to sea from the mouth of the Waikari River, which was particularly good for hāpuku and well-known as a spawning and nursery area for tāmure and other fish.
  - **Whakapao, Urukaraka, Te Ngaio-iti, Te Ngaio-Nui and Whakatapatu:** lying in an area slightly north of the mouth of the Moeangiangi River and south to the Waipapa Stream. These were all known as excellent places for catching hāpuku and for collecting kaiō, a type of filter feeding invertebrate good for medicinal purposes and eating. Whakatapatu was also a good place for catching moki and tarakihi.
  - **Hinepare and Makaro:** located near the mouth of the Arapawanui River.
  - **Kōtuku and Te Ahiaruhe:** located out to sea from the Arapawanui River. The former being known for hāpuku and the latter for tāmure.
  - **Tarahau:** located out to sea opposite the mouth of the Waipātiki Stream. This place was renowned for tāmure, tarakihi and moki.
  - **Rautoetoe and Te Una:** located out to sea opposite the mouth of Te Ngarue River. The former was known for tarakihi and the latter for moki.
  - **Panepaoa:** renowned for moki and a diving hole for crayfish.
  - **Kiore:** a rock shaped like a rat, near Te Areare beach. A good place to collect kaimoana.
  - **Tamatea:** a rock located at Tangoio and used as an indicator of whether it was low tide.

Tikanga

Tikanga provides us with a system of values which guides how we behave in certain situations. Our Hapū have tikanga relating to the gathering of kaimoana, including:

- saying karakia before and after collecting kaimoana, to provide safe passage and to give thanks. Those of us that can acknowledge tīpuna by name – Tangaroa, Hinemoana, Tangitū, Pānia, Moremore – conveying respect,
- not turning our back on Tangaroa,
- duty of care for our tīpuna and each other,
- not swearing while in the moana,
- our wāhine not entering into the moana when they have their ikura (menstrual period),
- collecting kaimoana at appropriate times and places,
- taking the right size and number of kaimoana,
- not shelling and eating kaimoana while any of our group is still in the water. This is considered an offence to Tangaroa and he could punish those still in the water,
- getting out of the water if our kaitiaki Moremore appears as a whai. That tells us there is danger lurking in the water,
- sharing kaimoana with the wider whānau.

An important tikanga is not to gather kaimoana when there is a rāhui. A rāhui could be placed on an area due to pollution or a tragedy occurring, making the area tapu.

This photo shows a rāhui being lifted by karakia by Kaumātua Matiu Eru in 2017.

(Puna 2020; Puna 2022; Taylor 2020a)

"The old people say haere ki rō wai, haere ki te moana, karakia"

Harata Taurima (Taylor 1993: 22).

"…nothing cooked could have been kept in that kete before you got the kaimoana, it had to be... specially made just for kaimoana"

Hinei Reti (2008: 1).

"I have said to my kids and grandkids, this area is theirs to look after. This is their home, look after it, don't clean the cupboards out, make sure there's something there the next day"

David Puna (2015: 3).

"Old people would say don't take too much or you'll chase the kai away"

Sally Taunoa (2008: 3).

Maramataka

Ka tuwhera a Tangitū, ka kati a Maungaharuru
Ka tuwhera a Maungaharuru, ka kati a Tangitū

When the season of Tangitū opens, the season of Maungaharuru closes,
When the season of Maungaharuru closes, the season of Tangitū opens

Our Hapū whakatauākī (described on page 12) relates to the maramataka. It describes the movement of our tīpuna which was dictated by the seasons.

Winter was the season for gathering kai from Maungaharuru and its surrounds. Summer was the season for gathering kai from the moana, awa, lagoons and surrounding lands (Reti 2015).

Whakataukī remind us to be guided by the tohu of Te Taiao.

Tuia ki te rangi,
Tuia ki te whenua,
Tuia ki te moana,
E rongo te pō, E rongo te ao

It is written in the heavens,
Upon the land, And the ocean,
And balanced between night and day

The whakataukī above speaks of "aligning what was happening in the heavens, sun, moon, stars and winds with that on land, trees, plants, birds, ocean, tides and fish movement"

(Solomon & Peach 2020: 1).

Tohu on the **whenua** tell us what is happening in the **moana** and align to stars in the **rangi**. For example, our tīpuna knew kaimoana is fat when kōwhai and other specific plants flower.

One of our Hapū experts on maramataka and rongoā, Jessica MacGregor explains her experiences growing up with maramataka:

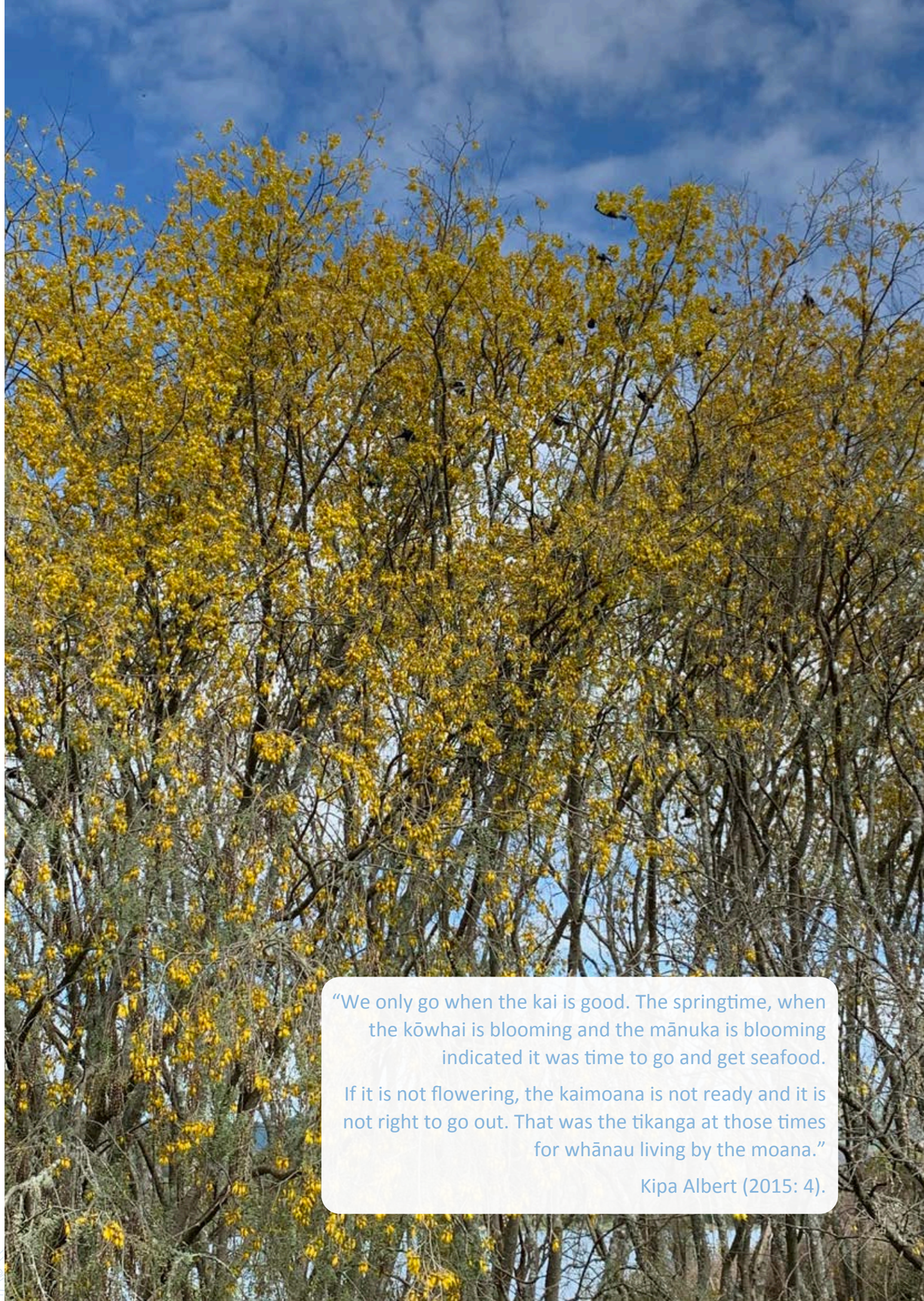
"We were always taught when to plant, when not to plant, based on the moon. And we just thought that was just Nanny Kura's way of doing things. But religiously that's what we followed. But if I think about it now, it is actually maramataka, because he taught us to read the environmental conditions; not only in the gardens, but when we went to gather kai over in Tangoio. … We would learn to read the water and the waves and the currents; learn to read the clouds and what weather is happening for what's been planted during what season. And that is actually what maramataka is all about; it's about following the moon phases, because … it's like your dimensions of time, and the seasons denote when the time is changing." Jessica MacGregor (2020: 18).

As tamariki, Jessica and others learned to observe and share what they saw. Adults would know when the time was right by the tamariki pointing out the environmental signs they were looking for.

"Tangitū was opened from October to January and closed from February onwards… But you know yourself when you want a kai, you can go any time as long as you go to the right place and be careful when you go that you're not breaking any customary rules or tikanga o te mahi kai."

Boyce Spooner (2009: 2).

It is important that we continue to observe and understand the maramataka in our own takiwā "based on our own environmental changes, whats currently going on" (MacGregor 2020).



"We only go when the kai is good. The springtime, when the kōwhai is blooming and the mānuka is blooming indicated it was time to go and get seafood.

If it is not flowering, the kaimoana is not ready and it is not right to go out. That was the tikanga at those times for whānau living by the moana."

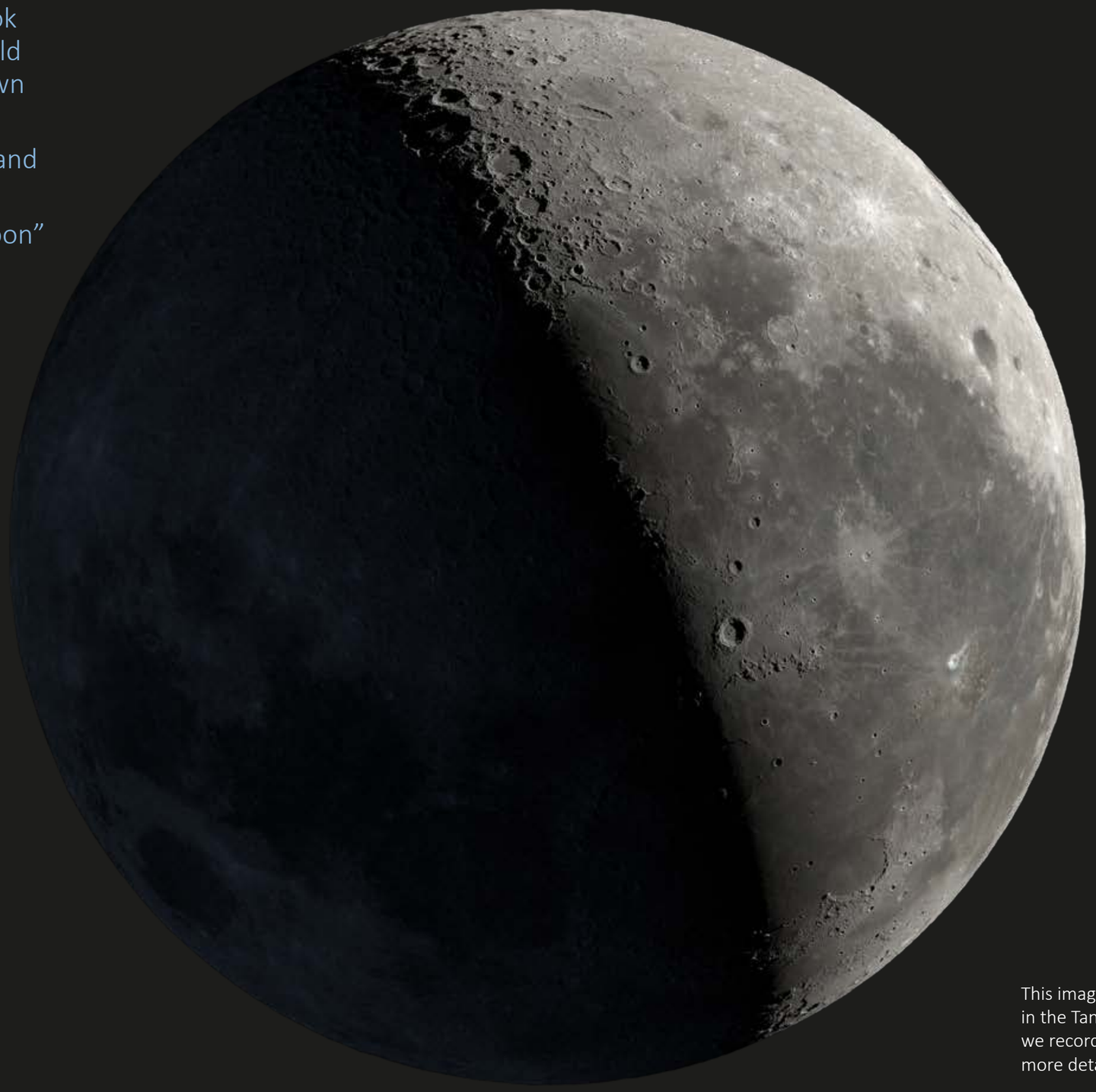
Kipa Albert (2015: 4).

“The old people would look at the moon and they would know what times to go down to the beach...

they would take us outside and look at the moon...

the shape and size of the moon”

Sally Taunoa (2008: 4).



Tangaroa

This image shows the moon on 17 November 2022, in the Tangaroa phase (Roberts et al. 2006), when we recorded our observations for the project (for more detail see page 116).

Image Credit: NASA’s Scientific Vizualization Studio

Ngā Mātāpono – Values

Tangoio Marae

Whakapapa

Whakapapa is a core value in Te Ao Māori. It is the kinship between all matter, whether animate (including people) or inanimate, genealogical connections and interdependence with each other.

"To be recognised as tangata whenua, you must have whakapapa to the relevant hapū, and be an active participant within that particular takiwā" (Puna 2020).

Mana & Tino Rangatiratanga

Mana is the authority passed down through generations to take action in the world, infused with the responsibility to care for the environment (kaitiakitanga) and people (manaakitanga). Mana whenua and Mana moana (authority over land and sea) belongs to the Hapū, the tangata whenua.

Tino Rangatiratanga is the expression of mana through leadership.

Tauutuutu

Tauutuutu upholds the reciprocal nature of all relationships and the inherent obligation to sustain them in balance. Tika embodies the rightness of actions, honouring and elevating mana and the ongoing enhancement of the wellbeing of Te Taiao and tāngata.

How values can guide environmental policies and practices

Whakapapa, mana, tino rangatiratanga, tauutuutu, kaitiakitanga and other core values of our Hapū drive our actions as kaitiaki. The importance of these values need to be embedded in the environmental practices and policies of our Hapū, as well as those of local and central government and other agencies.

For environmental governance and management, honouring whakapapa means placing the interdependence of Te Taiao and people at the heart of decision making, focusing on building long-term relationships and removing barriers to the collective wellbeing of Te Taiao and people as part of Te Taiao.

Recognising mana and tino rangatiratanga means that it is tangata whenua who make decisions about their own takiwā.

Tauutuutu can guide positive relationships between tangata whenua and others involved in environmental governance and management. It involves empathy, respect, co-operation and communication.

Kaitiakitanga

The relationship of our Hapū with the whenua and moana is one that is linked through whakapapa and through use, but also an obligation to ensure our land and waters are cared for and nourished. We are co-dependent with the whenua and moana (Hopmans 2020).

> "I'd like to see people get the kaimoana that I ate as a kid, especially the kina... pāua, mussels – all the shellfish that we were privileged to have and that were plentiful in our time...
>
> That the community will be sustained for generations from those same areas. It's only in the recent past that the deterioration came, so it was sustained – **our tikanga practices made it sustainable**"
>
> Fred Reti (2008: 5).

We have exercised our kaitiakitanga responsibilities to guard and protect Te Taiao in various ways. Some examples are set out below.

Rohe Moana & Moremore Mātaitai Reserve

In 1999, our Hapū gazetted a rohe moana (coastal marine area over which we exercise mana and kaitiakitanga, Te Kawanatanga o Aotearoa 2024). Confirmation of the rohe moana recognises our Hapū as tangata whenua with power to manage customary food gathering, through the appointment of tangata kaitiaki (Te Kāhiti o Aotearoa 1999, 2006).

In 2005, our Hapū established the first Mātaitai Reserve in Te Ika-a-Māui, the North Island. Mātatai reserves "recognise and provide for traditional fishing through local management. They allow customary and recreational fishing but usually do not allow commercial fishing" (MPI 2024a).

Our reserve is named Moremore Mātaitai Reserve after the kaitiaki Moremore, son of Pānia (see the map on page 22).

In the government press release at the time, Hon Parekura Horomia commented:

> "This is a great example of local Māori taking responsibility for their traditional fisheries. Creation of these reserves is simply a reaffirmation of their rights and responsibilities under the Treaty of Waitangi to manage their traditional fisheries"
>
> (Te Kāwanatanga o Aotearoa 2005).

The Hapū and Tangata Kaitiaki collaborated with NIWA on a project called 'Mātauranga Māori and sustainable management of New Zealand fisheries'. In 2011, we co-developed a guide that introduced important fisheries management information and 'good' practice techniques to consider for existing Mātaitai reserve management (May et al. 2011). Hapū members also participated in a land-based pāua and kina monitoring training workshop (May & Naylor 2012).

Pipeline Opposition

Pan Pac Forest Products Limited (Pan Pac) is a forestry, pulping and sawmilling business based at Whirinaki, within our takiwā.

- In 2012, Pan Pac was granted a resource consent to extend an outfall pipe 2.3km offshore on the seabed. The purpose was to avoid discharge colouration being conspicuous, and thereby causing non-compliance with the existing consent to discharge into Tangitū. Maungaharuru-Tangitū Trust, on behalf of our Hapū, appealed the decision.
- In 2017, Pan Pac applied for a coastal discharge permit and coastal occupation permit (for the pipe). The application was directly referred to the Environment Court, we opposed, and it ultimately resulted in a mediated outcome.
- A resource consent condition was the establishment of the Pan Pac Environmental Trust, the purpose of which is to mitigate the environmental and cultural impacts.
- Also, recognising that there are cultural impacts that cannot be fully mitigated, other resource consent conditions include Kaitiaki Monitors and the Independent Monitoring Review Group (IMRG) which review monitoring results, consider cultural impacts and recommend changes.

Wāhi Taonga

In 2014/2015 our Hapū sought to protect our wāhi taonga through provisions of the Proposed Hastings District Plan. It has been a long process including a Council Hearing, mediation, appeals through the Environment Court, High Court and Court of Appeal. In 2024, 55 of our wāhi taonga were formally ordered by the Environment Court to be included in the District Plan. The 55 wāhi include many of our coastal pā that will now have better protection from man-made damage and destruction.

Photo above: Pou tikanga, Kaumātua Bevan Taylor has given evidence in many Court Hearings.

Photo below: Tania Hopmans and Kaumātua Fred Reti present evidence on Maungaharuru at a Hastings District Council Hearing, while whānau listen in support (2015).

Photos:

Some of the whānau who gave evidence at the Takutai Moana High Court Hearing - (left) from Arapawanui: George Tawhai, Elizabeth (Olly) Puna, Puna Ote-Ora Brown, Waiata Brown-Sullivan, Marama Tareha-Te Hata, (below left) Trevor Taurima from Tangoio (2021);

(below right) Whakiao Hopmans, Tania Hopmans, Callum Beattie at a Hawke's Bay Regional Council Hearing about Tangoio Beach Development wastewater (2022).

(bottom) Manu Tāiko rangers with whānau after a planting day by Rangiātaahua Stream.

Takutai Moana

In 2014, MTT on behalf of our Hapū made a Marine and Coastal Area (Takutai Moana) Act 2011 application for Crown engagement and an application for recognition orders to the High Court in 2017. The application was for protected customary rights and customary marine title through recognition agreement with the Crown. The area we sought recognition orders over is shown on the map on page 22. In 2021, a High Court Hearing was held and Stage 1 decision was made. In 2023, MTT (and other parties) appealed the Stage 1 and 2 decisions. At this stage MTT has been granted:

- exclusive Customary Marine Title (CMT) over the area between Te Uku in the south and Arapawanui in the north, from mean high-water springs out to 12 nautical miles,
- a CMT jointly held by MTT and Ngāti Pārau over Pānia Reef,
- Protected Customary Rights at various specified areas including use of seawater as rongoā, use of tauranga waka, gathering sand, driftwood, shells, pumice, and rocks/stones, non-commercial whitebait fishing, and collecting karengo.

Te Ohu Urungi

MTT is part of Te Ohu Urungi, the Mana Whenua Steering Komiti working with other hapū and the Port of Napier on Port development activities that impact Pānia Reef.

Te Ohu Urungi have developed a Marine Cultural Health Programme called

Tangaroa Tohu Mana, Tangaroa Tohu Mauri (marineculturalhealth.co.nz).

Other Kaupapa

Maungaharuru-Tangitū Trust engages in various Taiao kaupapa. Some examples include:

- Current submission opposing the Fast-track Approvals Bill
- March 2024, letter to Ministers opposing the government's proposal to extend the duration of consents for existing marine farms due to the failure to consider: environmental impacts, changing environmental conditions, technological advances, climate change risks, some consents have already been grandfathered, impacts on Takutai Moana rights, and the proposal is not Te Tiriti compliant.
- In 2022 Hapū members presented evidence at a Hawke's Bay Regional Council Hearing. We opposed resource consent applications for proposed wastewater systems for a housing development at Tangoio Beach.
- In 2019, some mitigation of cultural impacts was achieved after many years of opposing the construction and operation of wind farms on Maungaharuru. We were unable to prevent the Harapaki Wind Farm, but working with Ngāti Hineuru we were successful in opposing two resource consent applications by Unison for other wind farms on Maungaharuru. Those cases were heard in the Environment Court and High Court.

Manu Tāiko

The Manu Tāiko (MTT Ranger Team) are engaged in restoring and protecting habitats and taonga species through direct actions such as planting, animal and plant pest control, fencing, feeding manu, monitoring fish passage, monitoring the health of the Tūtira lakes and associated cultural values (tuna, swimming, kākāhi; Ratana et al. 2024).

Tangitū Te Moana

Tangitū is a taonga.

Tangitū provides cultural, spiritual and physical sustenance, and is significant to the distinct identity and mana of our Hapū.

The importance of Tangitū is acknowledged in our mihi, whaikōrero, whakairo, kōwhaiwhai and tukutuku on our marae, whakatauākī, kōrero tuku iho and waiata.

The continued recognition of the Hapū, our identity, traditions and status as kaitiaki is entwined with Tangitū.

We have a responsibility as kaitiaki in accordance with kawa and tikanga to restore, protect and manage Tangitū.

"To me, mauri is the life, the breath, the spirit.

The mauri of the mussel is the indicator
of the mauri of Tangitū.

The mauri of Tangitū is an indicator
of the mauri of the Hapū.

These cannot be disconnected for they are the same.

We are Tangitū and Tangitū is us"

Matiu Eru (2016)

Ki uta ki tai, Ki tai ki uta

Ngā awa carry the lifeblood of Papatūānuku and the tears of Ranginui from mountain to sea. Each awa is an indivisible and whole entity, from its source to, and including, the moana.

There are numerous awa significant to our Hapū.

Te Ngarue is the awa that flows from the steep hills north of Tangoio, through Tangoio valley, alongside ancient wāhi taonga and our present-day Marae. It is also significant to our Hapū as it was a key mahinga kai, especially for tuna.

Pākuratahi is the awa that flows from the hills in the north east along the Pākuratahi valley. This awa was also significant as a mahinga kai and important in its proximity to wāhi taonga.

Both Te Ngarue and Pākuratahi flow into Tangitū through the same mouth at Tangoio Beach and onto important fishing reefs for our Hapū, including Panepaoa, Ngāmoerangi, Rautoetoe and Te Una.

Ngāmoerangi, Kuku Reef

On the south side of the mouth of the awa at Tangoio Beach is Ngāmoerangi, a coastal pā (which has largely been swept away by the sea), reef and beach.

The pā was occupied by Ngāti Tū and is highlighted in the kōrero about the arrival of Te Ruruku to this area. At that time, another hapū had been raiding the fishing grounds of Ngāti Tū and Ngāi Tatara (which later became known as Ngāti Kurumōkihi) at Tangoio and Tūtira. These issues led Marangatūhetaua, a chief of Ngāti Tū, to seek support from Te Ruruku, a chief from Wairoa. Marangatūhetaua needed to offer incentives to Te Ruruku to persuade him to settle among them. It was eventually agreed that Te Ruruku would occupy Ngāmoerangi pā which was the gateway to the fishing grounds at Tangitū.

Marangatūhetaua put his warriors at Te Ruruku's disposal. He also left his children Te Kauae and Hopu at the pā with Te Ruruku as a sign of good faith. Marangatūhetaua and his son Ngapoerau went to live at Te Rae-o-Tangoio, and their descendants have lived there ever since.

It was from Ngāmoerangi, that Ngāi Te Ruruku, Ngāti Tū and Ngāi Tatara would prevent waka taua that came across the bay from landing. This pā also afforded protection to their southern and western flanks from invasion overland.

Ngāmoerangi also features in the pūrākau of Māui-tikitiki-a-Taranga fishing up Te Ika a Māui.

Hapū tradition tells that when Māui-tikitiki-a-Taranga pulled up the fish, the waka that Māui and his whānau were on became stranded on top of the mighty fish. At the time, Māui warned his Uncle, Ngārangikataka, and others not to touch or cut up the fish. But they did not listen. They began to cut up the fish, creating the peaks and valleys that are seen today.

Māui was angry, and turned his Uncle and the waka to stone. Others tried to escape to the sea, towards Tangoio, but they too were turned to stone. Today they are in the form of Ngāmoerangi and Panepaoa, a small hill located just south of the Pākuratahi Stream.

Te Waka-o-Ngārangikataka can also be seen, high on the ridgeline of Maungaharuru *(mid-right of photo above. The flat part behind the taurapa of the waka is its wake.)*

Ngāmoerangi therefore has a rich history.

Ngāmoerangi, Kuku Reef

The reef we see today at the river mouth is so renowned for kuku that it is commonly known to the Hapū as “Kuku Rock” or “Mussel Rock”. It was considered a great resource and used by many of our whānau (Walzl 2020b). Kuku Rock is therefore a wāhi taonga and mahinga kai.

Kuku rock is close to shore and exposed at low tide. A swimmable distance out to sea is another rock with kuku (Ratima 2008). The whole reef covers a larger area and kuku could be found throughout (Taurima, R. 2008).

“Te kāpata kai ā tō tātau kuia, kaumātua”

The food cupboard of our kuia & kaumātua
Matiu Eru (pers. comm. 2023)

Our Kuia and Kaumātua shared mātauranga tuku iho in an interview series in 2008. Some of their personal stories are provided here.

Our Kuia, Sally Taunoa, described memories from when she was a child in the 1940s. She remembered a kaumātua who used to ride his horse into the river mouth and swim it into the sea and out to the kuku rock when people were collecting kuku. He would ask them to put kuku into his sacks, all while he remained on the back of the horse. She said they didn’t mind fulfilling the kaumatua’s request. (Taunoa 2008).

Later in life, when he was living in town, Sonny Ratima (2008) from time to time would catch a taxi out to the mouth of Te Ngarue and tell the driver to return in an hour. Using an inner tube with a net suspended below it he would dive for kuku and fill his net in 40 minutes.

Harvesting kuku at Kuku Rock was part of whanaungatanga. Trevor Taurima (born in 1945) described how during his childhood Te Ngarue river mouth formed the basis of his days with his friends. He spoke of his fond memories of this time:

“we spent a lot of time, us four, down at the mouth, just by ourselves. And we’d just drop into the water and collect kuku and throw it on the fire. And we would catch herring because they were just there and throw them on a tin on the fire and eat away ... You learned the skills of life.” (Taurima, T. 2008).

He also referred to subsequent years as a teenager when he and his friends regularly gathered kaimoana for fun.

Rangi Spooner (born in 1957) recalled:

“From being a young boy all the way through college everybody from the valley would go diving at the beginning of the season of the year, through the 1950s all the way through into the 1970s. Then they would do the same thing at the end of the season. We would fish for the day and everyone got heaps of fish and mussels”. (Spooner, R. 2015).

The gathering of kaimoana continues to be an important part of whānau life for Hapū members. In addition to kaimoana being an important part of diet, fishing continues to be viewed as an enjoyable family activity. Michael Brown spoke of often taking his children and his moko to collect kaimoana so they could leam the things he had been taught. He emphasised that in addition to the pleasure of eating of kaimoana, this activity was fun for their whānau. (Brown 2008).

“We were always guaranteed a feed there and it was handy, a lot of good times ... walking around there with the grandmother and grandfather and just doing the usual, going out and getting a feed”

Hoani Taurima (2008).

Photos from the 1980s:

(above) Teaiorangi (Tom) Taurima cooking on a fire at the rivermouth by Kuku Reef;

(right) with his mokopuna – Hoani Taurima, Aroha Taurima and Tamati Pahi;

(below) more of Teaiorangi’s mokopuna enjoying the rivermouth.

Thanks to the Taurima whānau for sharing these photos, they will bring back memories for many of our other whānau.

Kuku

Tangoio was renowned for the quality of kuku (Taylor 2008).

Kuia Harata Taurima, who was born in 1908, explained that when kaimoana was gathered, some would be prepared for storage and "the remainder they would share among the wider whānau".

"We would return with the kaimoana putting the kina in the fresh water, then cleaning and preparing the pāua and kuku leaving them overnight, not eating them until the next day, this was another custom we observed." (in Taylor 1993: 23, 36).

Kuku were often dried as a method of preservation.

Violet Koko (born in 1915) noted: "Kuku at times were boiled, then threaded onto a line like beads and stored. You would place them on top of taewa and pūhā to steam and of course to make soup" (in Taylor 1993: 36).

During the 1940s, it was still necessary to thread kuku and dry them on a line to preserve them. Kipa Albert described how tamariki used these dried kuku and pipi as chewing gum (2020).

Trevor Taurima indicated that they gathered kuku only when they were fat and this was in spring and summer and to a lesser extent early autumn but not in winter (2008).

Kaimoana continued to sustain the families of those who were born in the 1950s and 1960s. Over the 1960s some households began to have freezers, and this meant that kaimoana could be stored and they did not have to go out so often.

Kaimoana continued to be a regular part of the diet for some whānau over subsequent years. Heitia Shane Hiha remembered how in the mid-1970s he would "dive every second week along our Tangitū coastline" (2016: 2). Hoani Taurima commented that when he was staying with his grandparents at Tangoio over summer "if we went diving, we'd be eating kaimoana all week, pretty much" (2020).

Bevan Taylor recalled that it was around 1975 that they began to notice their kuku rocks at Tangoio becoming depleted (2020b).

Hoani Taurima particularly noticed that from around the end of the twentieth century, there was a significant diminishing in the number of kuku that could be found in the area out from Tangioio. He further noted that around 2001, even one of the rocks favoured by himself and his grandfather for mussels, located about thirty metres out from the main reef, had very few kuku. Over the twenty-first century, rocks at Tangoio which had been covered with mussels in the past tended to just have little patches (Taurima, H. 2008).

In 2008, Bevan Taylor commented that it was necessary to go out to deeper areas to find kuku and remarked "Our Kuku Rock itself is no longer really obtainable in terms of kuku''.

Kuku available within the Maungaharuru-Tangitū coastal and marine area had become smaller by the twenty-first century (Taurima, R. 2008).

We have a strong desire to "get back to how it was" (wānanga participant 2022).

"Kuku [are] special, always been good to me, looked after me so well, I want to help."

(wānanga participant 2022)

Photo credit: NIWA

Waiata

He Taonga He Tapu

Nā Matiu Eru i tito

E kore e mōnehunehu te pūmahara
mō ngā momo rangatira o neherā
nā rātou i toro te nukuroa
o Te Moana-nui-a-Kiwa me Papatūānuku
Ko ngā tohu o rātou tapuwae
I kākahutia i runga i te mata o te whenua
He taonga he tapu
He taonga he tapu

Memories will not wane for those who preceded us.
Those who transcended the ocean of Moana-nui-a-Kiwa,
and journeyed upon this small earth called Papatūānuku.
They who have left us this legacy that blankets the face of Papatūānuku
Its presence is commanding.
It is a jewel, it is Tapu.

Kia Haruru a Maungaharuru

Nā Justin Puna i tito

Kia haruru a Maungaharuru
Me tūtira te puninga
Kurumōkihi, Ngāi Tauira e, Marangatūhetaua,
Ngāi Te Ruruku ki Tangoio
Nika rā ngā Hapū e

Papaki kau ana ngā tai o Tangoio, Tangitū,
Waipātiki, Arapawanui
Waiohingānga, Te Ngarue me Waikare ō tātau waiū e

Pokarekare ana ngā roto Orakai, Opouahi,
Waikōpiro, Tūtira, Te Pōhue
Punanga Te Wao hai pātaka kōrero mō āna whakahina e

Kia tairanga ngā mahi ki ngā pānga whenua,
me ngā waiū hoki
kia toitū te mana o Te Ao Tūroa
kia pūmau ai te wahanga mō ngā ino
Kia haruru a Maungaharuru
Me tūira te puninga.

Let the great mountain Haruru reverberate.
Resolute the family will be
Kurumōkihi, Ngāi Tauira, Marangatūhetaua,
Ngāi Te Ruruku of Tangoio
these are the sub-tribes

Breaking are the tides of Tangoio, Tangitū,
Waipātiki, Arapawanui against the cliffs
Our tributaries of vitality are Waiohingānga,
Te Ngarue and Waikare

The lakes of Orakai, Opouahi, Waikōpiro, Tūtira, Te Pōhue ripple
Punanga Te Wao is the house of knowledge for its descendants

Multiple layers of work are required for us to keep our land and our life providing waters immaculate so that the mana of the land of this world remains, thus our land, and waters can be held onto unwaveringly for our descendants.

Whakarongo Mai

Nā Tom & Tini Tahura, Liz & Rangi Taurima

Whakarongo mai te iwi nei
Tēnei te reo o mātou nei (mātou nei)
Haruru e te maunga
Te moana ā Tangitū

Piki mai rā, kake mai rā
Ngā iwi katoa
Anei mātou o Tangoio e

Ka kati a Tangitū (Tangitū)
Ka tūwhera a Haruru (Haruru)
Ka kati a te Maunga
Ka tūwhera a Tangitū

Nō reira rā, kia ora rā
Ngā iwi katoa
Anei mātou o Tangoio e
Anei mātou o Tangoio e

Photo: Marewa Reti, Marewa King, Kāhui King

Research Phases

Phase 1: Cultural Environmental Assessment Framework

At the heart of this project is our Hapū worldview and mātauranga tuku iho that ground the conceptualisation of He Kāinga Taurikura—a kaupapa Māori framework designed to guide the Hapū assessment of environmental taonga.

This framework emphasises cultural-environmental scales, embodying diverse dimensions of Maungaharuru-Tangitū whakapapa relationships, including the inseparable relationship of tangata whenua and Te Taiao.

Cultural monitoring serves as a vital tool for tangata whenua as we continue to build knowledge and delve deeper into our own understandings. This process is essential because it enables us to effectively communicate the relevance and validity of our mātauranga tuku iho to external decision-makers in the context of resource management. Our monitoring acts as another means to convey our Hapū perspectives, enhancing our ability to uphold Te Tiriti compliant management and decision-making.

On the next page is 'He Kāinga Taurikura', our Cultural Environmental Assessment Framework. The foundation for this framework was drawn from mātauranga tuku iho, including our whakatauākī.

It also builds from kōrero during three wānanga as part of this project and a wānanga from the Tūtira Mai Ngā Iwi project held in April 2018 at Tangoio Marae. Whānau expressed their needs for the framework, including:

- being from our Marae
- recognising the importance of interconnectedness (e.g Tangitū, Tāngata, Maungaharuru, Maramataka)
- to cover all the atua kaitiaki domains
- to be able to be used for different places in our takiwā (e.g. Tūtira, Maungaharuru, Tangitū)
- to have an ingoa Māori
- uphold tino rangatiratanga and active protection of taonga
- be underpinned by the values of kotahitanga, manaakitanga and aroha

The Framework incorporates tohu (specific mātauranga tuku iho 'indicators'). It will be complimented through the use of scientific indicators as tools to assist our Hapū achieve our aspirations.

The purpose of the kaupapa Māori framework is

- to set the foundation from our Hapū world view
- to guide and communicate cultural-environmental assessment of taonga
- to be useful into the future.

MAUNGAHARURU
TANGITŪ

He Kāinga Taurikura

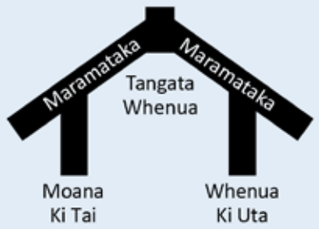
Our Cultural Environmental Assessment Framework

He Kāinga Taurikura (A Treasured Environment) is a kaupapa Māori framework that guides assessment of environmental taonga.
Tohu (from mātauranga ā-Hapū) and scientific indicators are selected from each of three aronga to describe hauora. The waharoa represents the connection of the aronga:

- **Tangata Whenua and our interactions with Te Taiao** (koruru)
- **Moana, Ki Tai** (left amo)
- **Whenua, Ki Uta** (right amo)

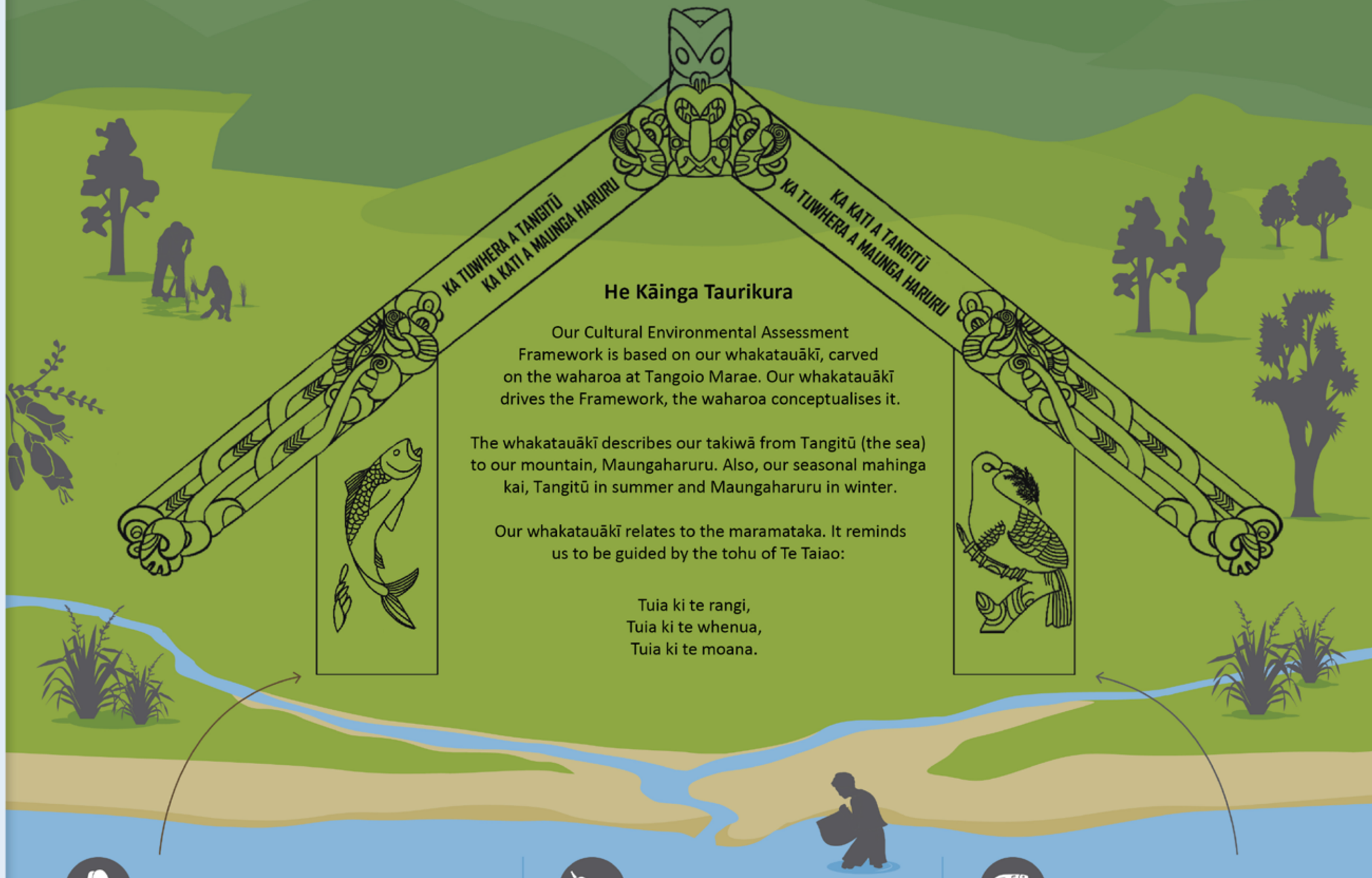
Ki uta ki tai, ki tai ki uta – acknowledging the water cycle

The Maramataka (Māori stellar-lunar-ecological calendar on the maihi) embraces all and guides us.



Our Hapū are Marangatūhetaua (Ngāti Tū), Ngāti Kurumōkihi (Ngāi Tatara), Ngāti Whakaari, Ngāi Tauira, Ngāi Te Ruruku ki Tangoio and Ngāi Tahu. Maungaharuru-Tangitū Trust is the voice and representative body. Our takiwā is north of Napier: from Keteketerau to the Waitaha River, from Maungaharuru Range in the west to Tangitū (the sea) in the east. This illustration is based on a photograph, Maungaharuru is visible at the top, the two awa are Pākuratahi (left) and Te Ngarue (right). The waharoa is a drawing of the actual carvings at Tangoio Marae.

tangoio.maori.nz
niwa.co.nz
sustainableseaschallenge.co.nz



He Kāinga Taurikura o Tangitū

We are focussing on one wāhi taonga in our moana, our mahinga kai Kuku Reef. We are describing hauora using tohu and indicators, at three cultural-environmental scales:

- **Kuku**
- **Kuku Reef**
- **Tangitū** (moana)

while acknowledging the influence of the water cycle, ki uta ki tai, ki tai ki uta.

Maramataka

We are reigniting our mātauranga ā-Hapū including the Maramataka, that applies to all of our cultural assessments. The moon phases guide the timing of our activities. Tohu on the **whenua** tell us what is happening in the **moana** and align to stars in the **rangi**. For example, our tīpuna knew kaimoana is fat when kōwhai and other plants flower.

Te Waiū o Tūtira

We are assessing the hauora of roto and awa at Tūtira on Maungaharuru, around three key values identified through wānanga ā-Hapū: tuna, kākahi and swimming. It is important that tohu and indicators are included for awa, as they are the pathways for tuna migration to and from the moana.

Phase 2: Wānanga learnings

For this project we have focussed on three cultural-environmental scales:

- Tangitū
- mahinga kai – we chose Kuku Reef
- kaimoana – for this study, kuku.

We had wānanga for kaitiaki to:

- exchange knowledge of practices and their relationship with Te Taiao, Tangitū, Kuku Reef and kuku
- express mauri and describe the state and pressures faced by these taonga – Tangitū, Kuku Reef and kuku
- identify tohu (cultural indicators) to assess the hauora (health, spirit of life, vigour; Mead 2016) of mahinga kai such as Kuku Reef
- consider criteria and scientific approaches that could be useful in assessing the scientific indicators relevant to our goals.

For more detail see Appendix A.

Te Tumu Tangitū

Te Tumu Tangitū is a Hapū advisory group formed for this project. The group includes whānau who are experienced divers, kaumātua, and kaitiaki.

(left to right): Nevada Nathan, Dayna Peterson, Joe Tawhai, Cliff Tarau, Robin Taurima, Rangi Tawhai, Rhodes Kihi-Apuwai, Carl Cotter, Joeseph Taurima, Whetumārama Kire, also Kaumātua Bevan Taylor *(not pictured)*. In front are Lara (Dayna's daughter), and project co-leads Kelly May and Hayley Lawrence (Leigh Tait was also a NIWA co-lead *not pictured)*.

Wānanga 1

Te Tumu Tangitū (the Hapū Advisory Group) exchanged mātauranga, aspirations, concerns, and actions related to Tangitū, mahinga kai (Kuku Reef), and kaimoana (kuku). They expressed concerns about the impacts of sediment and pollutants from land, as well as the stirring up of sediment from waves, currents, trawling and dredging practices.

Wānanga 2

Te Tumu Tangitū considered scientific approaches (tools, methods and technologies) along with kuku biology, including its life cycle, general threats, and specific threats at Kuku Reef. Criteria for selecting different scientific approaches were discussed. They also dissected kuku to examine their anatomy closely.

Pilot Fieldwork Observation

NIWA staff conducted fieldwork to trial various scientific approaches. The boat crew received a mihi whakatau from our Kaumātua, CEO, and MTT staff. Te Tumu Tangitū member Nevada Nathan joined the team on the boat, guiding them to locations, sharing kōrero, and observing the use of technologies. On Tangoio Beach, NIWA scientists demonstrated eDNA collection, observed by the Manu Tāiko (MTT Ranger Team).

Wānanga 3

Te Tumu Tangitū and other kaitiaki from our Hapū shared kōrero about whakapapa, hauora and mauri. Strong themes included the desire to strengthen our connections to Te Taiao, understand more and pass on mātauranga tuku iho, including tikanga, to our tamariki, revive expressions of cultural values through established and new compositions, be more active kaitiaki and uphold tino rangatiratanga, and active protection of taonga.

1 — 2 — Field — 3

Whāinga – Goals

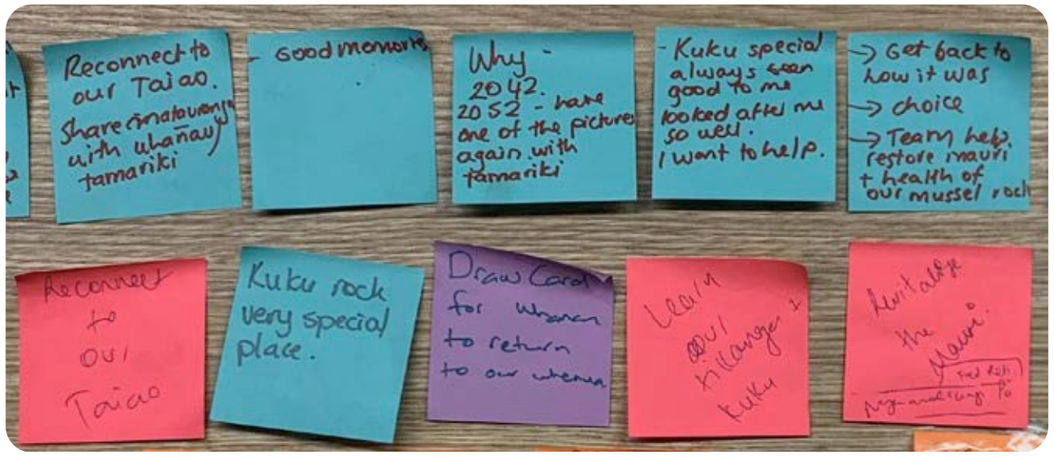
Summary of Goals and Perspectives

The goals of this project and the perspectives of our Hapū, shared during wānanga and through the previous work of MTT, are listed below. (For more details see Table 1 in Appendix B.)

1. Mātauranga tuku iho and cultural values are reinvigorated.
2. Kuku Reef and Tangitū are healthy and taonga species thrive.
3. Kuku are safe to eat.
4. Kuku are plentiful – sustainable for our future generations.
5. Well-informed decision making that is Te Tiriti compliant.

Photo (right): kuku are such an important taonga to our Hapū they are carved on the waharoa to our Marae.

Photo (below): some of the whakaaro shared by Te Tumu Tangitū in wānanga.



Mātauranga tuku iho and cultural values are reinvigorated

From the wānanga there was a strong desire as active kaitiaki to reinvigorate our mātauranga tuku iho, create new mātauranga, be more active and present with our whānau, tamariki, mokopuna at our mahinga kai and wāhi taonga, such as Kuku Reef.

Haere ki ngā wāhi taonga,
kia ako, kia rongo,
i te wairua,
i ngā tohu o Te Taiao,
arā, i ngā kihi maitai.

(Go to wāhi taonga to learn, connect to atua, to feel, sense, the signs of Te Taiao, the murmurings of the moana.)

Karakia

Whānau want to use relevant karakia when going to the moana, ngahere, awa. To assist our whānau who are at the earlier stages of the journey in te reo me ngā tikanga, our Hapū reo expert, Justin Puna, composed karakia to provide safe passage and give thanks. The karakia are intentionally simple so that they are accessible to many of our whānau, including tamariki.

They acknowledge the realms of Tangaroa, Hinemoana, Tāne, Papatūānuku, Ranginui and Tāwhirimātea.

(The karakia are in Appendix C).

Photo: Hoani Taurima with niece Rehutai and nephew Tāwaka Taurima at Tangoio Beach.

Using mātauranga tuku iho to assess hauora

Ngā Arotake – Survey Tools

Goals 2, 3, 4 relate to the hauora of our mahinga kai at Kuku Reef. To assess these goals using tohu from our mātauranga tuku iho, we developed three surveys based on our wānanga, mātauranga tuku iho and guided by the maramataka.

A brief overview of each survey is provided below, with more detail in Appendix C. We are open to sharing more of this kaupapa with other hapū / iwi on request (as MTT resources allow).

Tirohanga Tohu Observational Survey

This survey helps to strengthen our relationship with Tangitū, by calling us together at Kuku Reef for a shared purpose. It also focusses our attention on the tohu of Te Taiao.

The survey form was created using ArcGIS Survey 123 software. It can be filled in on any type of phone / tablet / computer, online or offline (which is especially useful in remote areas).

The information our Hapū collect over time will grow our mātauranga and māramatanga, and alert us to changes in Te Taiao.

Tangitū (mātauranga ā-kairuku)

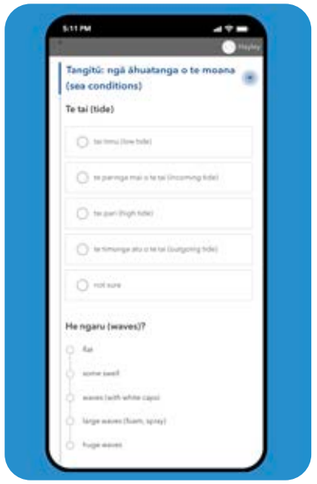
This survey is targeted towards our Hapū divers, who have specialist knowledge and experience that is very valuable to our Hapū. It is called Tangitū because she was a renowned diver.

Panepaoa (mātauranga ā-Hapū)

This survey is important in monitoring the hauora of our wider Hapū relating to Tangitū.

As this survey is about our Hapū more generally, it can be answered by a small group of well-connected active Hapū members / MTT kaimahi. This survey is called Panepaoa, named after a small hill that looks over Kuku Reef but is not in the moana.

Another purpose of this survey is to monitor the success of initiatives such as wānanga to increase knowledge of taonga tuku iho and interactions with Tangitū, within our Hapū.



Maramataka

The maramataka guides us when to undertake the surveys – during the appropriate moon phase, and in different seasons.

Te Mata o te Marama

We planned to align with the Tangaroa moon phase as it is regarded as a highly productive time generally, but is especially connected to awa and the moana (Solomon 2022). Painting (n.d.) also notes that Tangaroa is a time when significant research progress can be made.

Te Houanga

Tangitū and Panepaoa are annual surveys and will be undertaken guided by our whakatauākī, i.e. *Ka kati a Tangitū*, when the season for collecting kaimoana from Tangitū closes. Our Pou Tikanga, kaumātua Bevan Taylor considers Tangitū closed after around April (Taylor pers. comm. 2022). The surveys reflects on activities during the previous open season.

Images:

(left) Tirohanga Tohu Survey, first trialled by Manu Tāiko. Deane King-Peters showing some interesting finds on the beach.

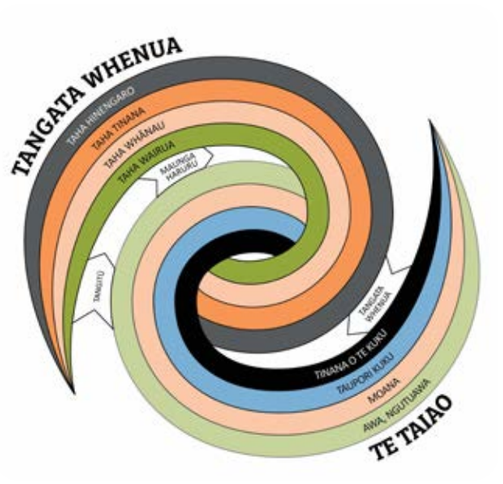
(below) Takarangi carved in our Whare Tipuna, Punanga Te Wao, which was digitised (right).

Hauora Visualisation Tool

We conceptualised a visualisation tool during this project. It builds on whakaaro from previous wānanga, and is recommended to be part of the next phase of development for the overall He Kāinga Taurikura – Cultural Environmental Assessment Framework. (More details in Appendix C.)

The takarangi could be used to visualise hauora assessment informed by mātauranga tuku iho. Our Pou Tikanga and Tohunga Whakairo, Kaumātua Bevan Taylor, offered the takarangi as a tohu for cultural-environmental assessment (Taylor, B. pers. comm. 2018). He explained that the takarangi is the "beginning of life... Rangi and Papa when they were joined together... Right in the centre is like a seed, the unborn, and as it spirals out ...the world of Rangi and Papa multiplied." (Taylor, B. pers. comm. 2018). We are descendants of ngā atua (Taylor 2006). The takarangi represents our whakapapa to ngā atua, and therefore our connection to Te Taiao.

For more information on the Hauora Visualisation Tool, including the tohu (cultural indicators) used to assess taha of hauora, see Appendix C.



Phase 3:

Setting the scene

The aims of Wānanga 2 were to provide Te Tumu Tangitū with an overview of science-based information and to discuss options for gathering insights about the current condition of Tangitū, Kuku Reef, and kuku.

One of our goals is to ensure that Kuku Reef and Tangitū are healthy and that taonga species thrive. However, achieving this requires substantial resources, specialised equipment and various skilled people.

During the wānanga, we discussed several key areas:

- Exploring kuku biology: We considered the kuku life cycle (Appendix D) and identified various threats to their wellbeing at different scales within the ecosystem. The threats spanned local, regional, and global levels (e.g. climate change, invasive species), affecting the health and sustainability of kuku populations.
- Science-based indicators and assessment approaches: We talked about different indicators that could be measured in alignment with our goals i.e. water quality, biological, contaminant, ecological and physical indicators along with some methods, tools and technologies for the pilot field study, collectively referred to as approaches.
    - Methods: Specific procedures used to collect data or conduct measurements, like collecting water samples to measure nutrient levels.
    - Tools: Devices or instruments used to collect data or analyse results, such as water quality meters or underwater cameras.
    - Technologies: Broader application of scientific knowledge, like using satellites or drones to gather data.

While highlighting the need for scientific expertise and the opportunities that this project presents, concerns were raised including:

- Cost of data collection: Regular sampling over an extended period is necessary to identify trends and detect changes, but this long term commitment is costly.
- Data analysis: Experts are needed to co-design studies, collect data, analyse results and spot significant changes.
- Reporting: Detailed reports are necessary to share findings with various audiences, tailored to their specific needs (beyond the scope of the pilot fieldwork).

Figure 1: Location of study sites within Te Matau-a-Māui, including Kuku Reef at Tangoio and the surrounding area. Google Earth Image © 2024, Maxar Technologies

Threats

During the wānanga, we discussed the significant impact of land-use changes on ecosystems.

Other threats discussed included pollution, biosecurity threats, overfishing, destructive fishing practices like trawling and dredging, land use intensification, runoff, and housing developments.

Climate change exacerbates these issues with marine heatwaves and severe storms.

It is estimated that only 34% of the original extent of native vegetation remains compared with before human settlement within the Hawke's Bay region (see Figure 2 below).

Additionally, rainfall mobilises exposed sediments, which then enter Tangitū, affecting ecosystems in several ways:

- Altering light and affecting photosynthetic organisms (e.g. kelp and seaweeds; Thoral et al. 2023, Tait 2019).
- Smothering and inhibiting species recruitment (Alestra et al. 2014).
- Interrupting filter-feeding organisms (Ellis et al. 2002).

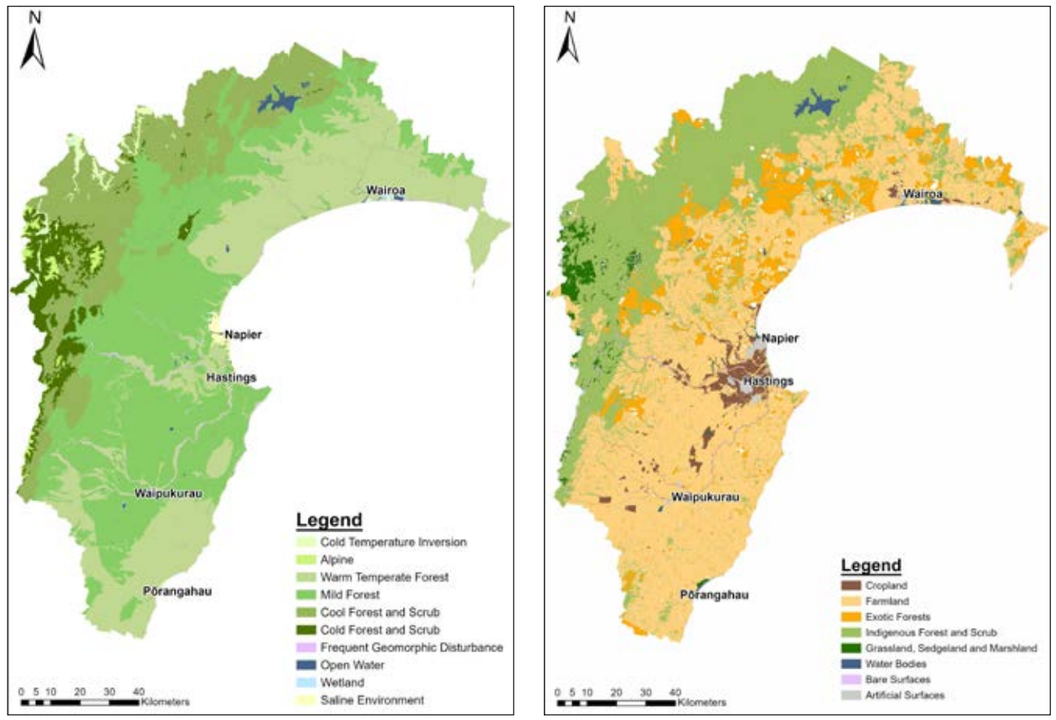
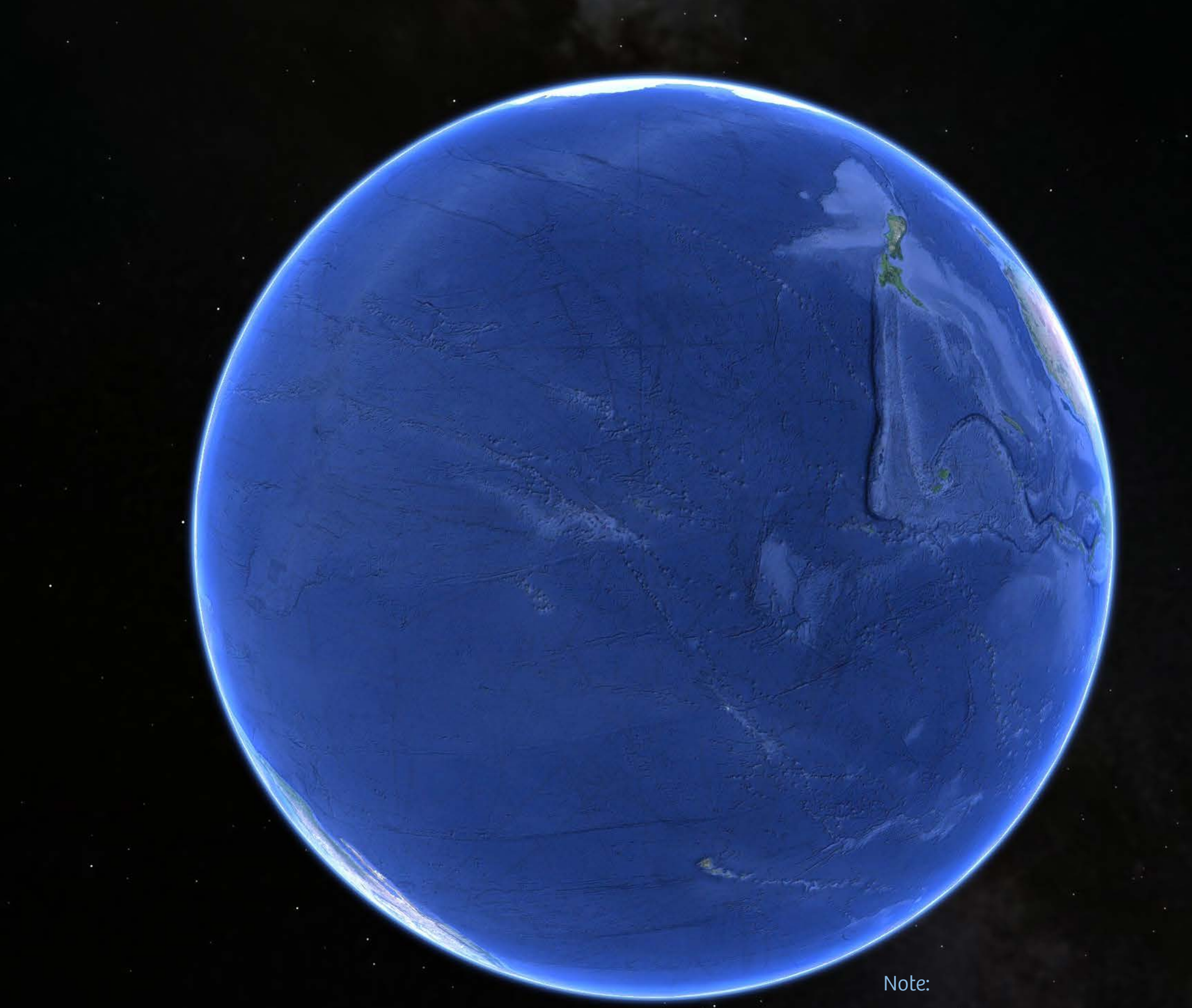


Figure 2: Estimated extent of native vegetation prior to human settlement (left) and extent of native vegetation remaining today (right). Sourced from Hawke's Bay Regional Council (HBRC 2021: 15).

These figures were provided by Hawke's Bay Regional Council (HBRC) in good faith. The figures are a complete copy of what was used in the HBRC State of Environment Report 2021. The data in these figures was compiled from a number of sources including HBRC, Biodiversity Hawke's Bay, Manaaki Whenua Landcare Research, and other third party sources. The use of these figures is subject to CC BY 4.0 INT licensing.

Figure 3: Satellite imagery of Te Matau-a-Māui in May 2023, three months after Cyclone Gabrielle. Source: European Space Agency, Sentinel-2.

Figure 4: Satellite imagery from September 2022, when Tangoio received over double the average rainfall for the month (220%; HBRC 2022). Thanks to Ted Conroy for the image, source: European Space Agency, Sentinel-2. Image from 22/9/2022.



Google Earth Image © 2024

Maxar Technologies

Note:

This image of Te Ao is orientated with the head of Te Ika-a-Māui to the top, to be more aligned with whakaaro Māori.

National and Global Scales

Our whakapapa relationships, including those within Tangitū, Te Matau-a-Māui and Te Moana-nui-a-Kiwa, beautifully connect us across Te Ao. In terms of science-based marine monitoring, we also need to consider national and global scales to help understand the broader impacts on our marine ecosystems. During wānanga, we touched on high-level climate change characteristics affecting marine life.

- Global Climate Patterns: The Interdecadal Pacific Oscillation (IPO) and El Niño-Southern Oscillation (ENSO), significantly impact ocean conditions, influencing the health of kuku and other marine life. These cycles cause shifts in ocean temperatures and nutrient distribution, affecting marine life and food sources like phytoplankton. For example, ENSO can bring cold or warm waters across Te Moananui-a-Kiwa to Te Matau-a-Māui, impacting species' physiology and food availability.
- Climate Change: Rising temperatures from long-term climate change intensify these cycles, leading to more severe impacts on marine ecosystems. These include increases in CO_2 concentrations, decreases in pH, changes in rainfall affecting salinity, and increased exposure to storms and cyclones.
- Ecosystem Health: Understanding these patterns helps identify issues like food shortages for kuku, stress from warm waters, or contamination from heavy rainfall. Environmental shifts can also affect the abundance and strength (or virulence) of pathogens. Monitoring biodiversity and the presence of invasive species also indicates overall ecosystem health.
- Local Impacts: These global patterns influence local weather, such as rainfall, and sediment runoff, affecting water quality and ecosystem health. Our Kuku Reef and kuku are affected by both local and global factors, impacting its marine community and the health of kuku.

Identify and apply different science-based approaches

The wānanga led Te Tumu Tangitū to conclude that Hapū kaitiaki might face challenges in independently planning, carrying out, interpreting, and reporting on science-based monitoring.

Therefore, collaborating with organisations is necessary for effective long-term monitoring. Additionally, this conclusion strengthened their goal to build long-term tohu monitoring by tangata whenua, highlighting the importance of recognising and interpreting environmental cues that quantitative metrics might miss.

To guide the selection of science-based approaches for the pilot field study, we developed a draft process and criteria to assess the suitability of different approaches (Appendices E & F). These are subject to further refinement and validation and consider both practical aspects and their importance to kaitiaki (Te Tumu Tangitū). The assessment involves specific questions, with some requiring yes / no responses and others rated on a scale (see Appendix F).

The following infographic shows the scientific approaches and indicators that were discussed with Te Tumu Tangitū during the wānanga. This visual representation helps to bridge the understanding between cultural-environmental scales (i.e. Maungaharuru ki Tangitū) and where different scientific methods could be applied.

Photo: Kelly May & Rachel Hale (NIWA) collecting water samples for eDNA analysis from the rivermouth

Scientific approaches discussed with Te Tumu Tangitū

KEY

Ecological Scale Assessed

- Kuku condition
- Reef population
- Tangitū (ocean)

Satellite data

- trends in climate change
- trends in sediment run-off
- changes in phytoplankton (kai for kuku)
- chlorophyll-a (kai for phytoplankton)

Water quality sampling

(not in this project)

- dissolved oxygen
- chlorophyll-a
- salinity
- turbidity (floating sediment)
- contamination (nutrients, heavy metals, bacteria)

Underwater drone

- habitat types (rocks, seaweed)
- kuku reef cover
- kuku reef density
- kuku sizes
- predator and competitor abundance
- fish diversity and abundance

eDNA metabarcoding

(from seawater)

- bacterial presence
- species diversity

Aerial drone

(not in this project)

- kuku reef area
- habitat types (e.g. rocks, seaweed)

Quadrat surveys

(not in this project)

- habitat types (rocks, seaweed)
- kuku reef cover
- kuku sizes
- predator and competitor abundance
- species diversity (not fish)

Towed / drop camera

- habitat types (rocks, seaweed)
- kuku reef cover
- kuku reef density
- kuku sizes
- predator and competitor abundance
- fish diversity and abundance

Lab-based histology

- microscopically look for parasites, bacteria, immune response

Condition index

- kuku health (growth, flesh weight)

Selected approaches

The science team identified key indicators and sought expert advice, including a review of the eDNA-related components.

Ideally, Te Tumu Tangitū and the science team would have collaborated in another wānanga to apply the criteria, discuss and select the approaches together. However, due to time pressures for conducting fieldwork in suitable conditions, the science team took on this responsibility independently.

They then implemented the science-based approaches for the pilot field study. The following approaches were used:

Tangitū:

- Satellite data
- eDNA metabarcoding from seawater

Kuku Reef:

- Underwater drone underwater habitat mapping
- Towed / drop-camera underwater habitat mapping
- eDNA metabarcoding from seawater

Kuku:

- Lab-based histology and Condition index
- Kuku faecal coliform testing

The team employed a range of approaches, combining both conventional tools, which have established global precedents for robust use (e.g. lab-based kuku histology and condition analysis involving standardised laboratory techniques and protocols), and emerging tools that are increasingly used to complement them (e.g. eDNA metabarcoding). (See Appendix G for brief descriptions.)

Each tool is constrained by scale, with some being useful at large scales and others at small scales. The trade-off in scale typically results in a reduction in resolution. Broad-scale tools, such as satellite and drone imagery, tend to have coarse resolution and are unable to provide detailed information at small, local scales.

Photos:

(top) underwater drone at Punakērua

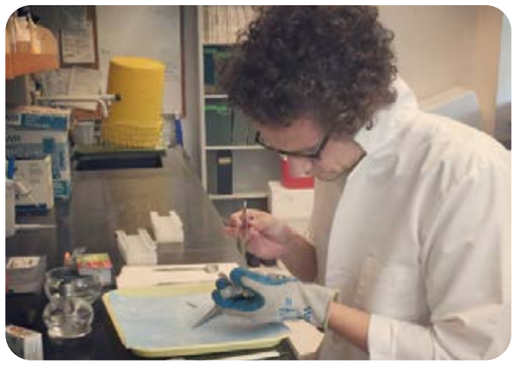
(above) Towed or Drop-camera

(right) Kelly May (NIWA) collecting a water sample from the rivermouth for eDNA;

Kelly assisting Rachel Hale (NIWA) to filter eDNA from seawater samples at Tangoio Beach;

Kuku sampled from Kuku Reef, Tangoio;

Henry Lane (NIWA) dissecting kuku to examine condition and histology.



Pilot study

In November 2022, NIWA staff conducted fieldwork to trial various scientific approaches. The boat crew received a mihi whakatau at the Ahuriri Boat Ramp from our Kaumātua Bevan Taylor and Matiu Eru, CEO, and MTT staff. Te Tumu Tangitū member Nevada Nathan joined the team on the boat, guiding them to locations, sharing kōrero, and observing the use of different approaches.

On Tangoio Beach, NIWA scientists Rachel Hale (below right) and Kelly May (below left) demonstrated eDNA collection, observed by the Manu Tāiko (MTT Ranger Team). NIWA sampled water from the river mouth, and water and kuku from Kuku Reef.

Summary of Pilot results

The results showed that the ecosystems in Tangitū were structured according to exposure to pressures caused by humans, particularly sedimentation.

- Ecosystems north of Kuku Reef and away from degraded river catchments – Whakaari and Punakērua – showed signs of healthy ecosystems with high coverage of habitat-forming seaweeds such as the golden kelp *(Ecklonia radiata)*.
- Ecosystems south of Kuku Reef at Te Uku, are closer to a major river catchment Te Waiohingānga (Esk River) and have high exposure to sediment. These ecosystems were dominated by different species – red algae, and kaiō (sea tulip, a filter feeding invertebrate).
- eDNA results revealed similar patterns south to north, although through a different set of species.
- Kuku Reef itself was a mixture, moderately dominated by brown seaweed *(Carpophyllum spp.),* coralline algae (pink encrusting or tufting algae), golden kelp, and red algae. Kuku beds on the southern part of Kuku Reef were dense with signs of juveniles amongst adults. Kuku were also plentiful on seaward parts of the wider reef.
- The condition index of kuku was similar across all sites, though the subtidal kuku had overall greater body condition than the intertidal sites.
- No significant parasites or pathogens harmful to humans or kuku health were found, with the kuku's condition index aligning with other reports from Aotearoa-NZ. However, high quantities of faecal coliform bacteria (*E. coli* from tūtae) were found in kuku on and around Kuku Reef suggesting that the nearby river catchments may be affecting the suitability of these populations for eating.

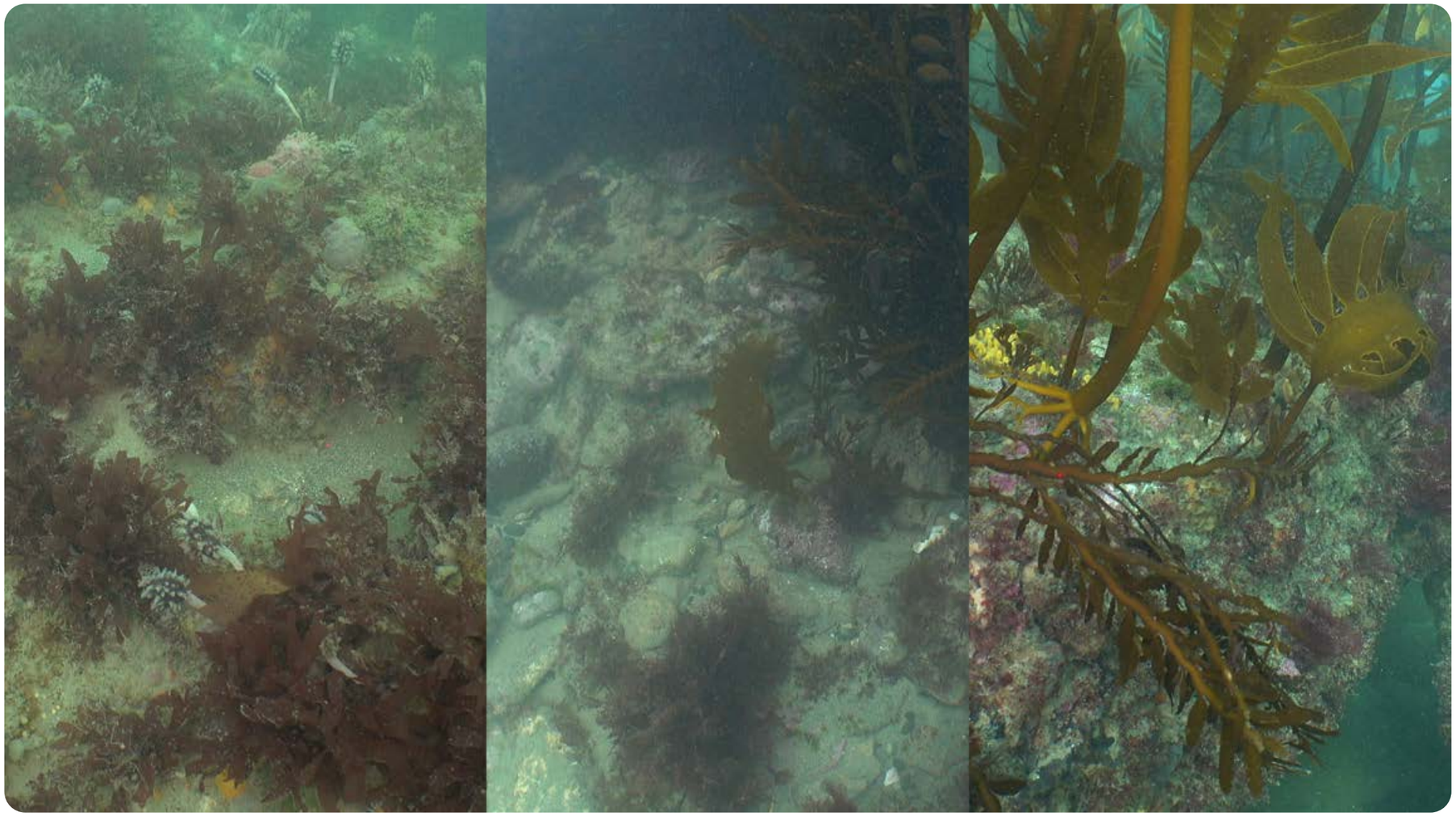


Figure 5: example images from the three main study areas. From left to right: Te Uku, Kuku Reef and Punakērua. These sites represent a gradient of exposure to sedimentation, with clear differences in the seafloor communities shown.

Sedimentation is...

"a natural process but many human activities on land make it worse. Activities that churn up the soil or remove or change the vegetation, like forestry, earthworks and farming can speed up the process and the amount of sediment significantly" (DOC 2024).

Sediment from the seabed can be stirred up from trawling and dredging, creating sediment plumes (Tatauranga Aotearoa 2016).

Sediment can smother species such as kuku (MfE 2019).

To find out more about sedimentation from land, see www.doc.govt.nz/coastalsediment

Suitability of Approaches

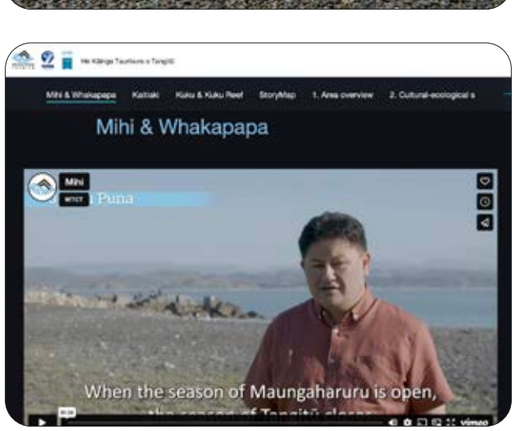
A range of approaches can help assess the health of kuku, Kuku Reef, and the general health of Tangitū. However, not all methods are necessarily suitable or needed all of the time. For example, ecological communities may take some time to respond to gradual shifts in the environment and can often be resilient to more sudden stressors, and eDNA datasets can miss conspicuous species (e.g. sea tulips). Monitoring more generic indicators of ecosystem health could be performed on a less frequent basis, i.e. every 1-5 years, or following major events (e.g. Cyclone Gabrielle).

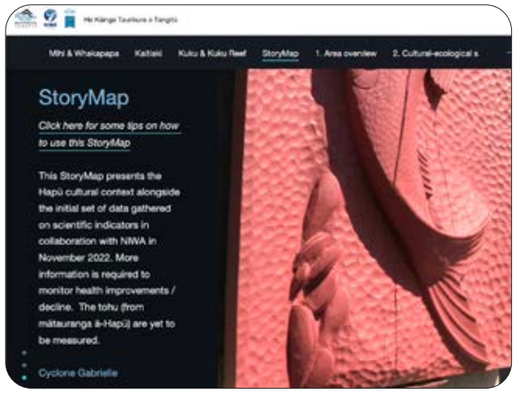
Other indicators may benefit from more frequent monitoring, especially those related to the safety of kaimoana consumption (e.g. faecal coliform bacteria / *E. coli* and Paralytic Shellfish Poisoning PSP). Results showed that intertidal populations exceeded human health guidelines for raw consumption, while subtidal populations exceeded guidelines for raw and cooked consumption.

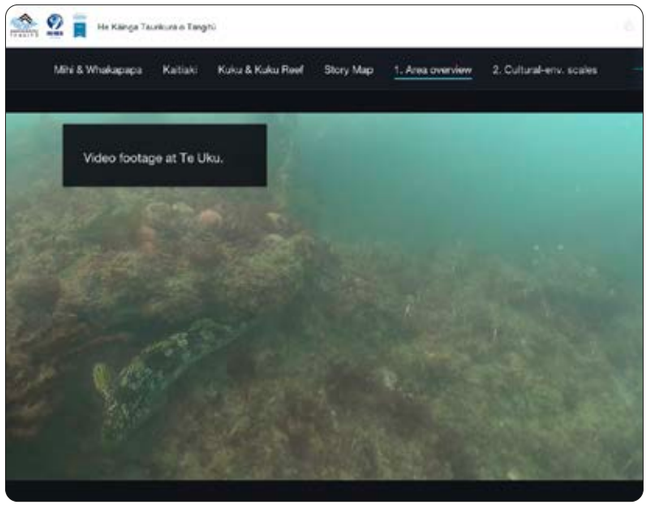
Story Map

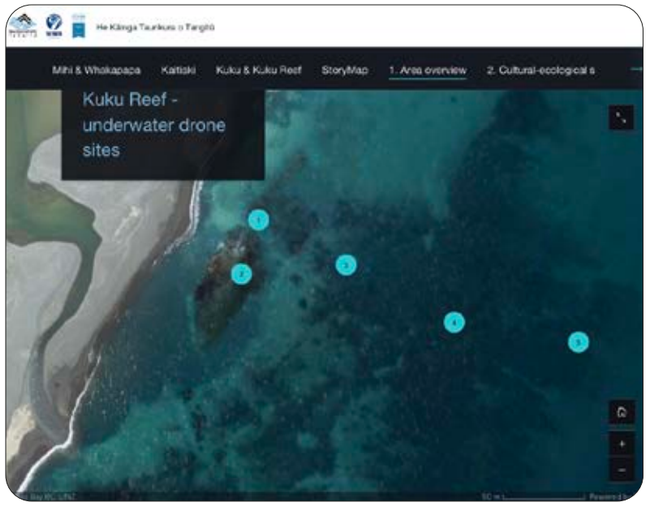
We also visualise some mātauranga tuku iho, seafloor maps and pilot study results on the Story Map platform. It is accessible at:

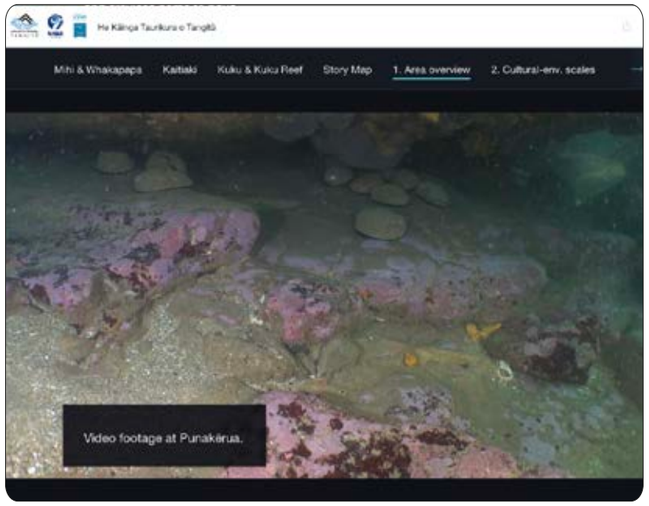
www.tangoio.maori.nz/kukustorymap











Recommendations – He Kāinga Taurikura Hapū Implementation Plan

1. Reinvigorate mātauranga tuku iho and cultural values.
2. Strengthen relationships and enhance resourcing for building Hapū capability and capacity.
3. Address sedimentation and erosion.
4. Complement tohu monitoring with science data for a broader understanding.

The aim is to inform the development of a Hapū Implementation Plan, particularly considering the impacts of Cyclone Gabrielle and restoration efforts, and to incorporate an inclusive approach to environmental assessment and management.

He Kāinga Taurikura emphasises the deep interconnection between land, water, and all living beings, insisting the need for a paradigm shift to ensure the holistic governance and management of marine ecosystems.

Understanding and representing mātauranga tuku iho, including our cultural-environmental scales, is crucial for inclusive and holistic governance and management of marine ecosystems. Some key challenges MTT experience include:

- The dominance of Western worldviews in decision-making (e.g. economics, extensive range of laws, regulations, and policy, predominant focus on quantitative scientific approaches by regulatory agencies, unequal power structures, short-term outlook, extractive nature of resources).
- Inappropriate application or interpretation of tikanga and mātauranga by decision-makers.
- Erosion of mātauranga and tikanga over time due to Crown breaches of Te Tiriti, causing our Hapū to suffer the loss of virtually all of our lands, the degradation of our taonga, hardship, crippling poverty, appalling health, and the loss of many whānau lines who died out as a result (Maungaharuru-Tangitū Hapū et al. 2013).
- Navigating and aligning with multiple, often conflicting and fragmented legislative and regulatory frameworks that typically do not adequately recognise or accommodate the values, knowledge, and practices inherent in mātauranga tuku iho.
- Lack of capability and capacity within agencies and Hapū to effectively work together.

Recommendation 1:

Reinvigorate mātauranga tuku iho and cultural values

- Strengthen connections between tangata whenua and Te Taiao that promote balance between people and the environment.
- Embed the importance of whakapapa, mana, tino rangatiratanga, tauutuutu, kaitiakitanga and other core values of the Hapū in environmental practices and policies.
- Embed He Kāinga Taurikura (Cultural Environmental Assessment Framework) and progress:
    - Implementing Ngā Arotake tohu monitoring by tangata whenua, to monitor and detect changes in the hauora of taonga i.e. Tangitū, Kuku Reef, and kuku. For instance, our tīpuna and kaitiaki observe flowering plants to gauge the readiness of different kaimoana (when the season of Tangitū is open); or track bird presence and behaviour, such as the feeding habits of kererū (when the season of Tangitū is closed).

      Kererū eat ripe miro berries in June, July, August, then kōwhai leaves when the miro berries are gone (Taylor 1993).
    - Developing the Hauora Visualisation Tool, to effectively communicate hauora assessments informed by tohu monitoring, indicating trends over time.
    - Advocate for decision making processes that respect mātauranga tuku iho including our cultural-environmental scales.
    - Maintain control over the use and sharing of mātauranga tuku iho.
    - Install an i-Pou as a communication tool to promote appreciation and awareness.

The priority recommendation is to reinvigorate our mātauranga tuku iho and cultural values to improve the hauora of both our people as tangata whenua and the hauora of Tangitū, Kuku Reef, and kuku by:

- encouraging whānau to visit and observe Te Taiao using all of their senses, guided by the Tirohanga Tohu survey – Haere ki ngā wāhi taonga, kia ako, kia rongo, i te wairua, i ngā tohu o Te Taiao, arā, i ngā kihi maitai. (Go to wāhi taonga to learn, connect to atua, to feel, sense, the signs of Te Taiao, the murmurings of the moana.)
- holding activities at the beach, e.g. hīkoi, pure, waiata, kohi rāpihi (collecting rubbish)
- wānanga to share whakaaro and learn waiata, haka, tikanga, karakia, maramataka, pūrākau etc.
- creating toi Māori (artworks) and new compositions to recognise and celebrate the importance of Tangitū to us.
- engaging our kairuku to teach our rangatahi to safely collect and prepare kaimoana, our ringawera to teach how to cook kaimoana.
- encouraging and creating opportunities to be active kaitiaki, physically participating in restoring Te Taiao in ways which will positively impact Tangitū, Kuku Reef and kuku.

Artwork by Karina Reti

To ensure mātauranga tuku iho evidence is appropriately weighed and understood alongside science in natural resource management, such as EBM, the following are suggested:

- advocate for policies that enable mātauranga tuku iho to be appropriately weighed and understood alongside other knowledge in natural resource management.
- document mātauranga tuku iho including Hapū-specific tikanga, traditions, and knowledge.
- pilot and support the implementation of Ngā Arotake – the three mātauranga tuku iho survey tools.
- strengthen succession by training more whānau members in Hapū tikanga, kawa, and mātauranga to be authoritative sources.
- advocate for the recognition and validation of mātauranga in decision-making processes.
- develop a guideline to present mātauranga tuku iho as 'evidence', including how to document, verify, protect and present.
- support advocacy efforts that better recognise mātauranga tuku iho in legal frameworks, policies and decision-making processes, to develop mechanisms that protect Te Taiao i.e. while the 'Legal Personhood' may not perfectly align with Te Ao Māori, as tangata whenua do not place human rights above the rights of Te Taiao, it serves as a tool to protect Tangitū, Te Matau-a-Māui, and Te Moana-nui-a-Kiwa.

Implement Ngā Arotake, tohu monitoring by tangata whenua, that includes seasonal tohu such as Ngā tipu puāwai (flowering plants), Ngā manu (birds), and Ngā tohu o te whenua (signs on land). For instance, our tīpuna and kaitiaki observe flowering plants to gauge the readiness of different kaimoana (when the season of Tangitū is open); or track bird presence and behaviour, such as the feeding habits of kererū (when the season of Tangitū is closed); kererū eating ripe miro berries in June, July, August, then kōwhai leaves when the miro berries are gone, Taylor 1993).

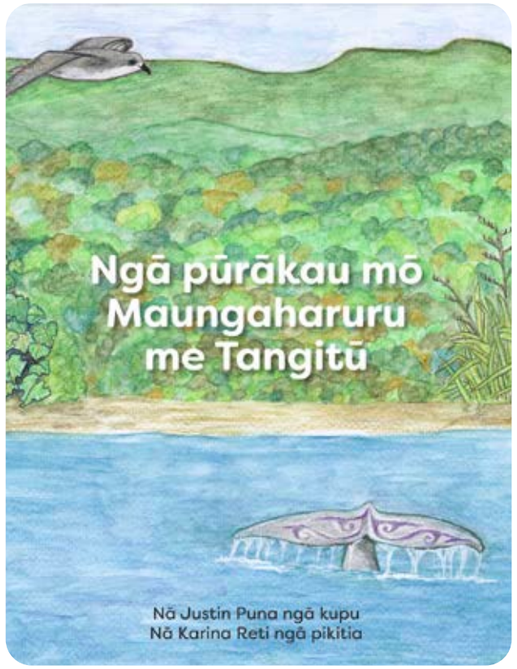
To install the i-Pou as a communication tool.

i-Pou Concept

We aim to promote recognition, appreciation and desire to restore and protect Tangitū with our whānau, local community and the wider public. To engage people while they are on location, MTT intends to install an i-Pou at Tangoio Beach. An 'i-Pou' is a post constructed from modern, durable materials that allows the user to connect to digital content. Designed in a contemporary style by a Hapū artist, it will serve as an interactive information hub.

Digital content will be accessible via QR codes installed on the i-Pou, providing two levels of access: general information for the public and more detailed information for our Hapū (accessible via a password-protected platform). Additionally, augmented reality features will enhance the user experience based on their proximity to the i-Pou.

The knowledge generated during the He Kāinga Taurikura o Tangitū project will highlight the significance of kuku, Kuku Reef, and Tangitū, as well as our efforts to protect and restore them. The i-Pou will offer dynamic content, allowing returning visitors to check for updates. Current information will help keep Hapū and public visitors connected. We are open to sharing more of this kaupapa with other hapū/iwi on request (as MTT resources allow).



These images are from our pukapuka, written by Justin Puna, illustrated by Karina Reti. The book tells two pūrākau, one of our mountain Maungaharuru, and the other of our sea Tangitū. The i-Pou will provide access to material from the pukapuka.

The image below illustrates Tangitū as a whale, a kaitiaki, a guardian for our people. If the river mouth is blocked, Tangitū will use her tail to clear the blockage so the water can flow again.

Recommendation 2:

Strengthen relationships and enhance resourcing for building Hapū capability and capacity

- Strengthen relationships to foster the delivery of actions that provide tangible benefits to Te Taiao.
- Advocate for equitable Crown and council resource distribution to support Hapū kaitiakitanga initiatives.

Hawke's Bay Regional Council Regional Planning Committee (RPC)

MTT holds a governance role on the Hawke's Bay Regional Council Regional Planning Committee (RPC), a joint committee of councillors and iwi representatives. MTT's membership on the committee, guaranteed as tangata whenua in the MTT Deed of Settlement, is reinforced by the Hawke's Bay Regional Planning Committee Act 2015, making the RPC a permanent committee of the Council.

The RPC is responsible for considering and recommending strategies, policies, rules, and other methods for inclusion in the Regional Resource Management and Regional Coastal Environment Plans. This governance role allows MTT to contribute its vision, values and goals to regional planning and environmental management, thereby advancing the implementation pathways of He Kāinga Taurikura.

Integrating Hapū Values with the Kotahi Plan: MTT will collaborate with the Hawke's Bay Regional Council on the Kotahi Plan, a comprehensive strategy for the sustainable use and care of Hawke's Bay's environment ki uta ki tai, ki tai ki uta. The Kotahi Plan integrates various environmental and resource management strategies to ensure the health and wellbeing of the region's ecosystems and communities. This plan will emphasise that "Tangitū is our Tino Tapu Tipuna (very sacred ancestor) and Taonga (treasure)" as stated by Matiu Eru in 2016.

Photo: Underwater scene at Whakaari; Leigh Tait, NIWA.

Recommendation 3:

Address Sedimentation and Erosion

Strengthen and advocate for actions and policies that protect and restore Tangitū (te moana) and Maungaharuru (te whenua).

- Advocate for Comprehensive Policies and Actions: Address regulatory gaps and harmful practices impacting both Tangitū (te moana) and Maungaharuru (te whenua), such as overfishing, bycatch, bottom trawling, dredging, and unsustainable land use. Support sustainable practices and stricter enforcement of regulations, incorporating mātauranga tuku iho into environmental management.
- Promote mātauranga Māori and education: Advocate for incorporating mātauranga Māori into education on sustainable fishing and land use practices. Inform communities about best practices and the importance of protecting both marine and terrestrial ecosystems in an integrated manner- ki uta ki tai, ki tai ki uta. Strengthen connections between tāngata and Te Taiao that promote balance between people and the environment.
- Strengthen enforcement: Advocate for stricter monitoring and enforcement of regulations to protect Tangitū and Maungaharuru from harmful activities.

Implement actions to prevent further soil dislodgement and to capture and settle soil particles that have already been eroded.

Enhance environmental management through collaborations with partners to:

- Map Landscape Changes: Estimate erosion and deposition volumes across the takiwā and identify 'hotspots.' Link these with regional variability in land-cover / use, topography, and geology to inform targeted interventions.
- Predict River Instability: Assess the remobilisation and transportation of material eroded during the cyclone from Maungaharuru sub-catchments to Tangitū. This will help predict areas at risk and plan accordingly.
- Forecast Flood Hazards: Examine how evolving river morphology may influence future flood hazards. Understanding these changes will aid in planning effective flood mitigation strategies.
- Implement targeted land-based actions with partners to reduce erosion and sedimentation impacting Tangitū, focusing on high-risk areas identified through mapping and analysis.
- As part of the 'Kia eke Te Ngarue' Kaimahi for Nature project, continue the 2022 efforts to fence and implement riparian planting of Te Ngarue to restore the awa flowing onto Kuku Reef. Prioritise planting in high-risk areas identified through mapping and analysis to supplement plants lost due to the cyclone, reduce erosion and sedimentation, and improve water quality by mitigating sediment load, nutrient overload, contaminants and improving habitat quality.

Restoration using biogenic methods

- Consider defining restoration goal(s) and a plan for implementing restoration using biogenic methods, such as establishing natural structures within Tangitū to enhance habitat for our kuku and mitigate sedimentation impacts.
- Biogenic methods can:
    - Enhance Habitat Provision: Create living habitats, such as kuku beds, providing shelter and breeding grounds for various marine species.
    - Support Biodiversity: Encourage a variety of species to flourish, promoting ecological resilience and stability.
    - Mitigate Sedimentation Impacts: Kuku bind and stabilise sediments, reducing sediment mobility.
    - Filter and Clean Water: Kuku filter particulate matter and pollutants from the water, to improve water quality.
    - Promote Carbon Sequestration: Kuku beds contribute to carbon capture and storage, helping mitigate climate change.

Photo: Golden Kelp at Whakaari; Leigh Tait, NIWA.

Recommendation 4:

Complement tohu monitoring with science data for a broader understanding

Science approaches that are accessible:

Consider employing science methods that are accessible for the Hapū and collaborate with relevant agencies to:

- develop a program alongside the tohu monitoring to collect kuku safely for analysis.
    - This may involve setting up a protocol for tangata whenua to conduct standardised visual kuku health condition assessments
    - Coordinate kuku testing, laboratory analysis and reporting with HBRC or other agencies to check tissues for health and signs of disease (histology) and testing for bacterial contamination, particularly faecal coliform bacteria / *E. coli.*
    - Encourage whānau to follow New Zealand Food Safety guidelines (MPI 2024b) by thoroughly cooking mussels to avoid illness especially if they have low immunity, are hapū (pregnant), or are kaumātua.
    - Stay updated on marine toxic algal bloom warnings and advisories from Manatū Ahu Matua Ministry for Primary Industries (MPI 2024c) and use MTT communication channels to promptly alert the Hapū to warnings within Tangitū.
    - Use *E. coli* kuku contamination data to inform harvesting guidelines i.e. include a stand-down period for harvesting after significant rainfall events.
- develop tools such as dashboards that make quantitative data (e.g. state of the environment monitoring data) available, relevant and understandable to the Hapū at cultural-environmental scales that are aligned with our whakatauākī seasons and maramataka phases.
- utilise satellite data to monitor water quality indicators for Tangitū, such as sea surface temperature (SST), chlorophyll-a, and turbidity, in combination with other monitoring methods like kuku condition analysis and tohu monitoring.
- note the design, collection, analysis, and reporting of quantitative scientific data are costly and may require long-term collaboration, effort, and expertise. While eDNA methods for marine coastal monitoring show considerable promise, like any approach they have limitations and require specialist skills to analyse and interpret. As eDNA and other science methods advance, reconsider their applicability and effectiveness alongside tohu monitoring.

Photo: Kuku at Punakērua; Leigh Tait, NIWA.

Photos:

(above) Kuku Reef, Tangoio; Leigh Tait, NIWA.

(right) authors Hayley Lawrence and Kelly May at Kuku Reef with Hayley's son Tāwaka Taurima.

Mihi Whakakapi

We acknowledge our Kāhui Kaumātua, Te Tumu Tangitū and Hapū kaitiaki, who attended wānanga and provided kōrero for us to collate into this report.

Also, Tangaroa Tohu Mana Tangaroa Tohu Mauri (Marine Cultural Health Programme) and Te Ohu Urungi (Mana Whenua Steering Komiti) for sharing their learnings.

Justin Puna, tohunga reo, for his input and advice.

Tekiteora Rolleston-Gabel, Environmental Researcher (Te Kūwaha / NIWA), and Tana Peterson, Kevin Rollinson, Deane King-Peters (MTT Manu Tāiko Rangers) for feedback on the Tirohanga Tohu survey.

Thanks to Leigh Tait (project co-leader), Rachel Hale, Henry Lane, Stephanie Mangan (NIWA scientists) and Emilee D. Benjamin (University of Auckland) for phase 3 science-based contributions including the summary pilot fieldwork results and presentation of seafloor maps via Story Map.

Louis Olsen, Stuart Mackay (NIWA) and Jon Stead (former NIWA technician) for their support during pilot fieldwork.

Erica Williams (Te Kūwaha) for project support, Graeme Inglis and Sean Handley (NIWA) for their review of phase 3 contributions.

Cameron Ormsby, Aquaculture Environmental Ltd, for advice regarding kuku *E. coli* and biotoxin monitoring.

Hayden Moffitt, expert boat skipper from Ocean Adventures.

Ko Ngā Moana Whakauka – Sustainable Seas National Science Challenge and Te Kūwaha (NIWA's National Centre for Māori Environmental Research) for funding.

Nā te ngākau oha o ngā mahi a ngā kaitautoko o te kaupapa i tutuki ai ngā wawata.

I kura-takahi-puni tātau kia pai ake ai tā tātau noho i te ao nei.

Mei kore koutou, mei kore koutou.

Glossary of scientific terms

Approaches *Tools, methods and technologies*

Biogenic *Produced by living organisms*

Chlorophyll-a *Chlorophyll-a measures the productivity of marine ecosystems and indicates the presence of phytoplankton, the tiny microscopic algae that form the base of the marine food web and produce oxygen.*

***E. coli* (*Escherichia coli*)** *E. coli (Escherichia coli) is a bacteria found in the intestines of humans and animals. Some strains can cause serious food poisoning and infections. Contamination in kuku can cause health risks if eaten.*

Erosion *Erosion is the process of removing and transporting materials such as soil and rocks from the whenua, while sedimentation is the process of depositing those materials in a new location, such as the moana.*

Marine Biotoxins *Marine biotoxins are naturally occurring toxic compounds produced by certain species of algae in the moana. These toxins can accumulate in kuku and can cause serious illness or even death in humans if consumed. Biotoxins are not destroyed by cooking or freezing.*

Method *The specific procedure used to collect data or conduct measurements, like collecting water samples to measure nutrient levels.*

Sea Surface Temperature (SST) *Sea surface temperature (SST) is an indicator of climate change impacts because changes in SST reflect shifts in global climate patterns.*

Taxa *Taxa are groups of related organisms that are classified together based on shared characteristics. This can range from broad groups, such as kingdoms or phyla, to more specific groups like families, genera, and species.*

Technology *The broader application of scientific knowledge, like using satellites or drones to gather data.*

Tool *Devices or instruments used to collect data or analyse results, such as water quality meters or underwater cameras.*

Turbidity *Turbidity measures how clear or cloudy the water is, caused by particles and sediments suspended in it.*

Photo: Kelly May with kuku samples collected from Kuku Reef, Tangoio Beach.

Kuputaka – Glossary of Māori words

Āe	*yes*
Amo	*upright supports of the waharoa*
Aroha	*love, compassion*
Aronga	*focus*
Atua	*deity, supernatural being, ancestor with continuing influence*
Aua	*don't know*
Awa	*river, stream*
Hauora	*health, spirit of life, vigour (Mead 2016)*
Hawaiki	*ancient homeland*
He Kāinga Taurikura	*Our Treasured Environment (name of our cultural environmental assessment framework)*
Hīkoi	*walk*
Hinemoana	*female atua of the sea*
Hinengaro	*mind*
I-Pou	*modern post allowing user to connect to digital content*
Ikura	*menstrual period*
Ingoa Māori	*Māori name*
Kāhui Kaumātua	*elders' committee*
Kai	*food*
Kaikirimana	*contractor*
Kaimoana	*seafood*
Kāinga	*home, habitat*
Kairuku	*diver*
Kaitiaki	*custodian, guardian*
Kaitiakitanga	*guardianship, stewardship*
Kaitirotiro	*observer*
Kākahi	*freshwater mussel*
Kāo, kāore	*no*
Kāpata kai	*food cupboard*
Karakia	*ritual chants, prayer*
Karengo	*seaweed*
Kati	*close*
Kaumātua	*elders*
Kaupapa	*topic, subject, theme*
Kaupapa Māori	*Māori approach, Māori principles*
Kawa	*protocol, customs*
Kete	*basket*
ki tai	*seaward*
ki uta	*inland*
ki uta ki tai	*from Mountain to Sea*
Kīrehe	*animals*
Kōrero	*discussion*
Kōrero tuku iho	*history, oral tradition*
Koruru	*carved face on the gable of the waharoa*
Kōrure	*Mottled Petrel*
Kotahitanga	*unity, collective action*
Kōura	*crayfish*
Kōwhaiwhai	*painted scroll ornamentation*
Kuia	*female elder*
Kuku	*mussel*
Mahi	*bargeboards on the gable*
Mahinga Kai	*food-gathering place*
Maihi	*diagonal bargeboards of the waharoa*
Māmā	*mother*
Mana	*prestige, status, spiritual power*
Mana Moana	*authority over sea*
Mana Whenua	*authority over land*
Manaaki, Manaakitanga	*support, hospitality*
Manu	*bird*
Manu Tāiko	*MTT ranger team*
Manuhiri	*visitors*
Maramataka	*Māori stellar-lunar-ecological calendar*
Māramatanga	*understanding, enlightenment*
mātaitai	*seafood*
Mātaitai Reserve	*a type of customary management area*
Mātauranga	*knowledge*
Mātauranga ā-Hapū	*tribal knowledge*
Mātauranga ā-Kairuku	*divers' knowledge*
Mātauranga tuku iho	*knowledge passed down through generations*
Mauri	*life force*
Mihi	*greet, acknowledge, thank*
Mihi whakakapi	*concluding acknowledgements*
Mihi whakatau	*official welcome speech*
Moana	*sea*
Mōhiotanga	*local practice based wisdom*
Moko, mokopuna	*grandchild/ren, descendant*
Mōteatea	*traditional chant, sung poetry*
Ngā	*the (plural)*
Ngā Arotake	*survey tools*
Ngā tipu puawai	*flowering plants*
Ngahere	*forest*
Ngutuawa	*rivermouth*
Pākati	*joining features of the takarangi*
Pakeke	*adults*
Paketai	*what's cast on the beach*
Pao	*song*
Papakāinga	*village*
Papa, Papatūānuku	*Earth mother*
Pātai	*question*
Pou	*post*
Pou Tikanga	*protocol expert*

Poutiri Ao o Tāne	*a Hawke's Bay restoration project, focused on Maungaharuru ki Tūtira*
Pūhā	*a native green vegetable*
Pukapuka	*book*
Pūkenga	*skilled person*
Puku	*stomach, centre, seat of emotions*
Pūpū	*aka 'bubu'; winkle / cat's-eye (shellfish species)*
Pūrākau	*Hapū history*
Pure	*purification ritual*
Pūtake	*rationale*
Rāhui	*temporary ritual prohibition*
Rangatahi	*youth*
Rangatira	*chief*
Rangi	*heavens*
Ranginui	*Sky Father*
Rangona	*senses*
Reo	*language*
Ringawera	*kitchen worker*
Rohe Moana	*coastal marine area over which we exercise mana and kaitiakitanga*
Rongoā	*remedy, medicine, treatment*
Roto	*lakes*
Taewa	*potato*
Taha	*part*
Takarangi	*an intersecting double spiral pattern with special meaning*
Takiwā	*traditional area*
Takutai Moana	*Marine and Coastal Area (Takutai Moana) Act 2011*
Takutaku	*recite karakia*
Tamariki	*children*
Tāne	*atua of the forest and all that lives within.*
Tangaroa-i-te-Rupetu	*atua of the sea, waterbodies and all within them.*
Tāngata	*people*
Tangata Kaitiaki	*local guardian or trustee of a specific area, appointed under Fisheries Regulations.*
Tangata Whenua	*people born of the whenua, indigenous people*
Tangitū	*the sea within our takiwā; name of an ancestor, a spiritual guardian of the Hapū*
Taonga	*treasure, culturally valuable*
Taonga tuku iho	*heritage, treasures passed down through generations*
Tapu	*sacred; laws and protocols of the tīpuna*
Taupori	*population*
Tauranga Waka	*canoe / boat anchorage, mooring*
Taurapa	*sternpost of a waka*
Tauutuutu	*reciprocity*
Tāwhirimātea	*atua of the wind and storms*
Te Ao Māori	*the Māori world*

Te au o te moana	*currents*
Te Houanga	*season*
Te Huarere	*weather conditions*
Te Hurihanga Wai	*water cycle*
Te Ika-a-Māui	*The North Island*
Te Mata o te Marama	*phases of the moon*
Te Moana-nui-a-Kiwa	*Pacific Ocean*
Te Taiao	*environment*
Te Tiriti	*The Treaty (of Waitangi)*
Te Tumu Tangitū	*Hapū advisory group*
Te Whare Tapa Whā	*a wellbeing model developed by Durie 1984*
Tihi Tapu	*sacred peaks*
Tika	*true, correct, right*
Tikanga	*custom*
Tikanga o te mahi kai	*customs for gathering and preparing food*
Tinana	*body*
Tino Rangatiratanga	*self-determination, sovereignty, autonomy*
tipuna	*ancestor*
tīpuna	*ancestors*
Tirohanga Tohu	*Observational Survey*
Tītī	*muttonbird, Cook's Petrel*
Tohu	*sign, logo; specific mātauranga tuku iho indicators*
Tohunga	*expert*
Toitū	*to sustain holistically, to leave permanent*
Tukutuku	*ornamental lattice-work*
Tuna	*eel*
Tuwhera	*open*
Wāhanga	*sections*
Waharoa	*entrance to Marae*
Wāhi	*place*
Wāhi Taonga	*site of significance*
Wāhine	*women*
Wai	*water*
Waiata	*song*
Wairua	*spirit, soul*
Waka	*canoe, boat*
Waka Taua	*war canoe*
Wānanga	*forum, to meet and discuss, deliberate, consider*
Whaikōrero	*oratory, formal speech*
Whakaaro	*thought, opinion, idea*
Whakairo	*carving*
Whakapapa	*kinship, genealogical connections*
Whakapurenga	*purification ritual*
Whakatapatorutanga	triangulation
Whakatauākī	*proverb, saying; source known*
Whakataukī	*proverb, saying; author unknown*
Whānau	*family*
Whanaunga-tanga	*relationship, kinship, family connection*
Whare Tipuna	*ancestral house*
Whenua	*land*
Whētiko	*mudsnail*

Tohutoro – References

Albert, K. (2008) Interview. 28 May 2020.

Albert, K. A. A. I. (2015) Affidavit of Kipa Anaru Arapeta Inia Albert, re CIV-2011-485-799.

Alestra, T., Tait, L.W. and Schiel, D.R. (2014) Effects of algal turfs and sediment accumulation on replenishment and primary productivity of fucoid assemblages. Marine Ecology Progress Series, 511: 59-70.

Awatere, S. et al. (2017) Wai Ora Wai Māori – a kaupapa Māori assessment tool. Landcare Research Manaaki Whenua, Policy Brief No.19, June 2017.

Best, E. (1982) Māori Religion and Mythology Part 2. Hasselberg Government Printer, Wellington.

Brown, M. (2008) Interview. July 2008.

Cawthron Institute
https://edna.cawthron.org.nz/

Colenso, W., author., St George, I. compiler. (2019) William Colenso. The early journals: the missionary years, 1834 – 1853 / collected by Ian St George. Colenso Society, Wellington.

DOC, Te Papa Atawhai, Department of Conservation (2024) Facts about marine sediment. Website accessed 15 May 2024:
https://www.doc.govt.nz/nature/habitats/marine/threats-facing-our-oceans/sediment-and-our-coasts/facts-about-marine-sediment

Durie, M. H. (1984) Te taha hinengaro: An integrated approach to mental health. Community Mental Health in New Zealand 1(1): 4–11.

Ellis, J., Cummings, V., Hewitt, J., Thrush, S. and Norkko, A. (2002) Determining effects of suspended sediment on condition of a suspension feeding bivalve *(Atrina zelandica)*: results of a survey, a laboratory experiment and a field transplant experiment. Journal of Experimental Marine Biology and Ecology, 267(2): 147-174.

Eru, M. (2016) Statement of evidence of Matiu Eru, re ENV-2015-WLG-00052.

Govindarajan, A. F. et al. (2023) Advances in environmental DNA sampling for observing ocean twilight zone animal diversity. In Frontiers in Ocean Observing: Emerging Technologies for Understanding and Managing a Changing Ocean. Kappel, E. S. et al. (eds) Oceanography 36 (Supplement 1):80–86.
https://doi.org/10.5670/oceanog.2023.s1.27

Gray, K. (1996) Mrs Kuia Gray Statement of Evidence. WAI 201 J41.

Groves, M. and Clode, G. (2017) Environmental Code of Practice For River Control and Waterway Works. HBRC Report No. 3256.

Guthrie-Smith, H. (1926) Tutira: The Story of a New Zealand Sheep Station. Second Edition. Blackwood & Sons, Edinburgh & London.

Guthrie-Smith, H. (1953) Tutira: The Story of a New Zealand Sheep Station. Third Edition. Blackwood & Sons, Edinburgh & London.

Guthrie-Smith, H. (1969) Tutira: The Story of a New Zealand Sheep Station. Fourth Edition. A.H. and A.W. Reed, Wellington.

HBRC, Hawke's Bay Regional Council (2021) Hawke's Bay State of the Environment, 2018- 2021.

HBRC, Hawke's Bay Regional Council (2022) Hawke's Bay Trends, The State of Our Environment, September 2022.

Hiha, H. S. (2016) Statement of evidence of Heitia Shane Hiha, re ENV-2015-WLG-00052.

Hopmans, T. (2016) Statement of evidence of Tania Hopmans, re ENV-2015-WLG-00052.

Hopmans, T. M. P. (2020) Affidavit by Tania Marama Petrus Hopmans in support of the application for recognition orders under the Marine and Coastal Area (Takutai Moana) Act 2011. Re CIV-2017-485-241.

Hopmans, T. (2022) Statement of evidence of Tania Marama Petrus Hopmans on behalf of Maungaharuru-Tangitū Trust, re applications to Hawke's Bay Regional Council for consents (discharge permits) to discharge treated domestic wastewater to land at Tangoio.

Kaitiaki Contributors, Herangi, N., Ratana, K. (2023) Te Mauri o Waiwaia: A Maniapoto Freshwater Cultural Assessment Framework. Science Communication Summary Report prepared for Te Nehenehenui. Published by National Institute of Water and Atmospheric Research (NIWA) Ltd, Hamilton, New Zealand. ISSN 1174-264X. NIWA Information Series 96.

Kitson, J. C. et al. (2018) Murihiku Cultural Water Classification System: enduring partnerships between people, disciplines and knowledge systems. New Zealand Journal of Marine and Freshwater Research, 52: 511-525.

Lucas, D. (2020) Affidavit of Diane Jean Lucas ONZM in support of the application for recognition orders under the Marine and Coastal Area (Takutai Moana) Act 2011. Re CIV-2017-485-241.

MacGregor, J. (2020) Interview. 27 May 2020.

Maungaharuru-Tangitū Hapū, the Trustees of the Maungaharuru-Tangitū Trust, and the Crown. (2013) (1) Deed of Settlement of Historical Claims. 25 May 2013: 112.
http://tangoio.223.165.77.199.sth.nz/wp-content/uploads/2015/12/Maungaharuru- TangituHapuDOS.pdf;

(2) Deed of Settlement Schedule: Documents: 202.
http://tangoio.223.165.77.199.sth.nz/wp- content/uploads/2015/12/DOS_Documents.pdf

Maungaharuru-Tangitū Society Limited (1996) A video presentation to the Waitangi Tribunal. WAI 201 J38 (a).

Maungaharuru-Tangitū Trust (2015) Combined Compendium of Supporting Documents for All Sites of Significance (excluding confidential files). Submission on the Draft Hastings District Plan 6-7 May 2015.

Maungaharuru-Tangitū Trust (2016) Maungaharuru Tangitū Trust v Hawkes Bay Regional Council, re ENV-2015-WLG-00052.

May, K., Naylor, R., Breen. P. (2011) Providing information and tools to build Māori capability to manage their rohe moana and taonga species. Final Report for Ministry of Fisheries Project CRM2006-01. June 2011. 77p.

May, K., Naylor, R. (2012) Monitoring Pāua & Kina: Training Manual for Moremore Mātaitai. Training Manual for Maungaharuru-Tangitū Hapū members. April 2012. 43p.

May, K. (2022) Statement of evidence of Kelly May on behalf of Maungaharuru-Tangitū Trust, re applications to Hawke's Bay Regional Council for consents (discharge permits) to discharge treated domestic wastewater to land at Tangoio.

Mead, H. M. (2016) Tikanga Māori: Living by Māori Values. Revised Edition. Huia Publishers, Wellington.

MfE, Manatū Mō Te Taiao, Ministry for the Environment and Tataunga Aotearoa, Stats NZ (2019) Our marine environment 2019 Summary.

MPI, Manatū Ahu Matua, Ministry for Primary Industries (2024a) Managing customary fisheries. Website accessed 15 May 2024.
https://www.mpi.govt.nz/fishing-aquaculture/maori-customary-fishing/managing-customary-fisheries/

MPI, Manatū Ahu Matua, Ministry for Primary Industries (2024b) Food safety when fishing and gathering shellfish. Website accessed 2 May 2024.
https://www.mpi.govt.nz/food-safety-home/food-safety-tips-fishing-hunting-homekill/food-safety-fishing-gathering-shellfish/

MPI, Manatū Ahu Matua, Ministry for Primary Industries (2024c) Shellfish biotoxin alerts. Website accessed 2 May 2024.
https://www.mpi.govt.nz/fishing-aquaculture/recreational-fishing/where-unsafe-to-collect-shellfish/shellfish-biotoxin-alerts/

Painting, T. et al. (n.d.). Te Maramataka o te Rangahau: Envisioning a whakapapa-based ethic of time in Kaupapa Māori Research.

Parsons, P. (1993) The Mohaka-Waikare Confiscated Lands: Ancestral Overview (Customary Tenure) research report. Volume I. WAI 201 J18.

Parsons, P. (1997) Maori Customary Rights in the Ahuriri Block. WAI 201 R8.

Pinkerton, M. et al. (2023) NIWA Seas, Coasts and Estuaries New Zealand (NIWA-SCENZ): Image services of satellite (MODIS-Aqua) water quality products for coastal New Zealand. Data Product Version 5.0. NIWA, Wellington. Website accessed 15 May 2024:
https://nedc.nz/content/satellite-maps-of-seas-coasts-and-estuaries-new-zealand-niwa-scenz/

Pipiri, T & Body, V. (2010) Tihei-wa Mauri Ora. In: New Zealand Journal of Counselling 30 (1): 34-46.

Pishief, E. (2020) Affidavit of Elizabeth Dale Pisheif in support of application for recognition orders under the Marine and Coastal Area (Takutai Moana) Act 2011, re CIV-2017-485-2414.

Puna, D. W. (2015) Affidavit of David Whatanui Puna, re CIV-2011-485-799.

Puna, J. O. I. (2020) Affidavit of Justin Owen Ian Puna in support of application for recognition orders under the Marine and Coastal Area (Takutai Moana) Act 2011, re CIV-2017-485-241.

Puna, S. T. (2022) Statement of evidence of Sabre Te Rina Puna on behalf of Maungaharuru-Tangitū Trust, re applications to Hawke's Bay Regional Council for consents (discharge permits) to discharge treated domestic wastewater to land at Tangoio.

Ratana, K., Herangi, N., Williams, E. et al. (2024) Tūtira Mauri Ora Monitoring Action Plan 2022.

Ratima, S. (2008) Interview. 10 May 2008.

Reti, F. R. M. (1993) Brief of evidence of Frederick Roy Maadi Reti. WAI 201 D27.

Reti, F. R. M. (1996) Frederick Roy Maadi Reti Statement of Evidence. WAI 201 J37.

Reti, F. (2006) Statement of evidence of Frederick Reti on behalf of Ngāti Hineuru Iwi Incorporated and Maungaharuru-Tangitū Society Incorporated, re ENV-2006-WLG-000481.

Reti, F. R. M. (2008) Interview.

Reti, F. R. M. (2015) Affidavit of Fred Roy Maadi Reti, re CIV-2011-485-799.

Reti, F. R. M. (2016) Statement of evidence of Frederick Roy Maadi Reti, re ENV-2015-WLG-00052.

Reti, H. T. (2008) Interview. 29 March 2008.

Roberts, M., Weko, F., Clarke, L. (2006) Maramataka: the Māori Moon Calendar. Research Report No. 283, August 2006. Lincoln University, Christchurch.

Sequench. Website accessed 15 May 2024: https://www.sequench.co.nz/

Solomon, R. and Peach, M. (2020) Ngā kitenga o te Maramataka: The insights into the Māori Lunar calendars. International Journal of Integrated Care, 20(S1): A211: 1-8.

Solomon, R. (2022) E oho! Ngā kitenga o te maramataka: Insights into the Māori calendar. Recorded 15 July 2022, National Library of New Zealand. https://natlib.govt.nz/events/e-oho-nga-kitenga-o-te-maramataka-insights-into-the-maori-calendar-july-15-2022

Spooner, B. (2009) Interview. 29 March 2009.

Spooner, R. (2015) Affidavit of Rangi Aranui Spooner, re CIV-2011-485-799: 2.

SS, Ko Ngā Moana Whakauka Sustainable Seas Science Challenge (2024) Website accessed 15 May 2024. https://www.sustainableseaschallenge.co.nz/about-us/what-we-do/

Tait, L.W. (2019) Giant kelp forests at critical light thresholds show compromised ecological resilience to environmental and biological drivers. Estuarine, Coastal and Shelf Science, 219: 231-241.

Tamaariki, D. & Booker, L-J. (2022) The Mana Ora Framework. Website accessed 30 June 2022. https://www.joyoushq.com/solutions/mana-ora

Tatauranga Aotearoa, Stats NZ (2016) Commercial seabed trawling and dredging. Website accessed 3 May 2024. https://www.stats.govt.nz/indicators/commercial-seabed-trawling-and-dredging

Taunoa, S. (2008) Interview. 11 May 2008.

Taurima, A. (2022) Statement of evidence of Aroha Taurima on behalf of Maungaharuru-Tangitū Trust, re applications to Hawke's Bay Regional Council for consents (discharge permits) to discharge treated domestic wastewater to land at Tangoio.

Taurima, H. A. (2008) Interview. 27 June 2008.

Taurima, H. A. (2016) Statement of evidence of Hoani Allen Taurima, re ENV-2015-WLG-00052.

Taurima, H. A. (2020) Interview. 25 May 2020.

Taurima, H. A. (2022) Statement of evidence of Hoani Taurima on behalf of Maungaharuru-Tangitū Trust, re applications to Hawke's Bay Regional Council for consents (discharge permits) to discharge treated domestic wastewater to land at Tangoio.

Taurima, R. (2008) Interview. 10 May 2008.

Taurima, T. (2008) Interview. 8 May 2008.

Taylor, B. M. (1993) 'Mohaka-Waikare Confiscated Lands: Customary Usage Report', research report. WAI 201 J5.

Taylor, B. (2006) Brief of Evidence of Bevan Maihi Taylor on behalf of Maungaharuru-Tangitū Society Incorporated and Ngāti Hineuru Iwi Incorporated, re ENV-2006-WLG-000481.

Taylor, B. (2008) Interview. 30 March 2008.

Taylor, B. M. (2016) Statement of evidence of Bevan Maihi Taylor, re ENV-2015-WLG-00052.

Taylor, B. (2020a) Affidavit of Bevan Maihi Taylor in support of application for recognition orders under the Marine and Coastal Area (Takutai Moana) Act 2011, re CIV-2017-485-241.

Taylor, B. (2020b) Interview. 29 May 2020.

Taylor, B. (2022) Statement of evidence of Bevan Maihi Taylor on behalf of Maungaharuru-Tangitū Trust, re applications to Hawke's Bay Regional Council for consents (discharge permits) to discharge treated domestic wastewater to land at Tangoio.

Te Kāhiti o Aotearoa, New Zealand Gazette (1999) Fisheries (Kaimoana Customary Fishing) notices. 2 December 1999, 134: 4357. 1999-go8966. https://gazette.govt.nz/notice/id/1999-go8966

Te Kāhiti o Aotearoa, New Zealand Gazette (2006) Fisheries (Kaimoana Customary Fishing) notices. 13 November 2006, 137: 4001. 2000-go7958. https://gazette.govt.nz/notice/id/2006-go7958

Te Kawanatanga o Aotearoa, New Zealand Government (2005) New mataitai reserves for Hawke Bay. 11 August 2005. Website accessed 15 May 2024: https://www.beehive.govt.nz/node/23977

Te Kawanatanga o Aotearoa, New Zealand Government (2024) Rohe Moana. Website accessed 15 May 2024: https://catalogue.data.govt.nz/dataset/rohe-moana

Te Mana Raraunga, Māori Data Sovereignty Network (2018) Principles of Māori Data Soverignty. Brief 1. Website accessed 15 May 2024: https://www.temanararaunga.maori.nz/s/TMR-Maori-Data-Sovereignty-Principles-Oct-2018.pdf

Te Ohu Urungi, Mana Whenua Steering Committee (Komiti), Te Herenga Waka o Ahuriri, Napier Port (2021) Tangaroa Tohu Mana, Tangaroa Tohu Mauri, Marine Cultural Health Programme. Preliminary Report. April 2021.

Thoral, F., Pinkerton, M.H., Tait, L.W. and Schiel, D.R. (2023) Spectral light quality on the seabed matters for macroalgal community composition at the extremities of light limitation. Limnology and Oceanography, 68(4): 902-916.

Tipa & Associates Ltd. (2015) The cultural health of the Waitaki catchment. September 2015. Tipa & Associates Client Report prepared for Environment Canterbury: 176. https://api.ecan.govt.nz/TrimPublicAPI/documents/download/2430239

Tipa, G. & Teirney, L. (2006) A Cultural Health Index for Streams and Waterways: A tool for nationwide use. Ministry for the Environment, Wellington: 710.

Turei, M.; Kaa, W. and Kaa, T. (ed.) (1996) Mohi Turei: āna tuhinga i roto i te reo Māori. Victoria University Press, Wellington.

Vagias, W. M. (2006) Likert-type scale response anchors. Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management. Clemson University.

Waitangi Tribunal (2004) The Mohaka Ki Ahuriri Report. WAI201. Waitangi Tribunal Report 2004. Wellington, NZ: 798. https://forms.justice.govt.nz/search/Doscuments/WT/wt_DOC_68598011/Wai201.pdf

Walzl, T. (2020a). Affidavit of Tony Walzl in support of application for recognition orders under the Marine and Coastal Area (Takutai Moana) Act 2011, re CIV-2017-485-241.

Walzl, T. (2020b). Exhibit A to Affidavit of Tony Walzl in support of application for recognition orders under the Marine and Coastal Area (Takutai Moana) Act 2011, re CIV-2017-485-241.

Wilderlab https://www.wilderlab.co.nz/

Wood, S. A. et al. (2019) A comparison of droplet digital polymerase chain reaction (PCR), quantitative PCR and metabarcoding for species-specific detection in environmental DNA. Molecular Ecology Resources, 19(6), 1407-1419. https://doi.org/https://doi.org/10.1111/1755-0998.13055

Tāpiritanga – Appendices

Appendix A: Wānanga learnings

For this project we have focussed on three cultural-environmental scales:

- Tangitū
- mahinga kai – we chose Kuku Reef
- kaimoana – for this study, kuku.

We had wānanga for kaitiaki to:

- exchange knowledge of practices and their relationship with Te Taiao, Tangitū, Kuku Reef and kuku
- express mauri and describe the state and pressures faced by these taonga – Tangitū, Kuku Reef and kuku
- identify our goals
- identify tohu (cultural indicators) to assess the hauora (health, spirit of life, vigour; Mead 2016) of mahinga kai such as Kuku Reef
- consider criteria and scientific approaches that could be useful in assessing the scientific indicators relevant to our goals.

Te Tumu Tangitū

Te Tumu Tangitū is a Hapū advisory group formed for this project. The group includes whānau who are experienced divers, kaumātua, and kaitiaki.

The members of Te Tumu Tangitū are (standing left to right) in the photo (below right):

Nevada Nathan, Dayna Peterson, Joe Tawhai, Cliff Tarau, Robin Taurima, Rangi Tawhai, Rhodes Kihi-Apuwai, Carl Cotter, Joeseph Taurima, Whetumārama Kire, also Kaumātua Bevan Taylor (*not pictured*). In front are Lara (Dayna's daughter), and project co-leads Kelly May and Hayley Lawrence (Leigh Tait was also a NIWA co-lead *not pictured*).

Wānanga 1

In June 2022, Te Tumu Tangitū held wānanga to exchange their mātauranga, aspirations, concerns, and actions related to Tangitū, mahinga kai (Kuku Reef), and kaimoana (kuku). Whānau discussed and wrote their whakaaro on post-it notes, which were then placed on large A1 photos representing the three cultural-environmental scales.

Te Tumu Tangitū expressed various concerns including climate change, overfishing, the impacts of sediment and pollutants from land, and the stirring up of sediment from waves, currents, trawling and dredging practices.

During the wānanga, the kōrero was grouped under the following pou: Tangitū, Tāngata, Maungaharuru, Maramataka. This kōrero was later analysed under key patterns and themes within the kōrero for different parts of this project. The analysis informed He Kāinga Taurikura (Cultural Environmental Assessment Framework), and guided the focus of our mātauranga tuku iho survey tools, overall goals and related science-based approaches.

Wānanga 2

The aims of Wānanga 2 in October 2022 were to provide Te Tumu Tangitū with an overview of information and to discuss various options for gathering insights about the current science-based condition of Tangitū, Kuku Reef, and kuku, relevant to our goals.

We discussed climate change and specific threats to Kuku Reef. We also dissected kuku to closely examine their anatomy and considered their lifecycle.

Information was presented on how science could assist with Tangitū, Kuku Reef and kuku assessments using images and videos to describe different approaches.

The infographic on page 72 was co-developed by NIWA and the MTT co-leader prior to the wānanga and was later updated to illustrate the Hapū whenua (Maungaharuru) and sea-scape (Tangitū) and reflect the importance of including a method to assess if our kuku are safe to eat at the time of collection, a goal emphasised by Te Tumu Tangitū.

Criteria for selecting different scientific approaches were also discussed, including kaitiakitanga, health and safety, and cost.

The kōrero also highlighted the significant effort and cost required for quantitative scientific research. This led to a desire to learn more about science methods that are accessible to Hapū kaitiaki and a priority to focus on reinvigorating mātauranga tuku iho.

The kōrero helped in choosing the indicators and shaping the assessment criteria, which ultimately guided the science team in selecting approaches for the pilot field study.

Photo (right): Nani Taane, Coralee Thompson, Dayna Peterson, Kelly May, Carl Cotter, Joeseph Taurima, Robin Taurima & son, Rangi Tawhai.

Wānanga 3

In November 2022, at our third wānanga with Te Tumu Tangitū and other kaitiaki from our Hapū, we shared kōrero about whakapapa, hauora and mauri – the life energy that binds the spiritual and physical worlds, forming the basis of our spiritual relationship with Te Taiao.

For our Hapū, Tangaroa is the atua of the moana, waterbodies, and all within them. Tāne is the atua of the ngahere and all that lives within the ngahere. They are the sons of Papatūānuku and Ranginui, from whom the living beings, including Tangata Whenua, descend. This relationship underscores our dependence on the natural world and the importance of maintaining and respecting nature to preserve mauri and ensure the wellbeing of all life.

We highlighted how kuku is a taonga to our Hapū, carved on our Marae waharoa. Also that we are connected to kuku through whakapapa. Tangoio was renowned for the quality of kuku, with the Kuku Reef at the mouth of Te Ngarue and Pākuratahi Streams being a significant resource "loaded up with mussels". Offering kuku from our rohe moana is an important part of manaakitanga.

Our Kuku Reef is located within Te Matau-a-Māui, where the mauri of fish life was implanted by Ruawharo, one of the tohunga (high priests) of the Tākitimu waka. Ruawharo brought this mauri from Hawaiki on Tākitimu, establishing mauri and an abundance of marine life.

We introduced, though did not deeply explore, the continuous movement and transformation of wai that connects Papatūānuku and Ranginui and all living beings. We acknowledge the cyclical nature of 'Te Huringa Wai – ki uta ki tai, ki tai ki uta', which represents the journey of wai from the tihi tapu of Maungaharuru to the moana Tangitū and back, carrying the lifeblood of Papatūānuku and the tears of Ranginui. This cycle emphasises the interconnectedness of all wai, including awa, as they traverse our takiwā.

Te Ngarue and Pākuratahi awa, which flow near ancient wāhi taonga, were celebrated. Te Ngarue flows from the steep hills north of Tangoio, through Tangoio Valley, alongside our present-day Marae. Pākuratahi is the awa that flows from the hills in the northeast along the Pākuratahi Valley. Both awa merge and flow into Tangitū, nourishing our Hapū reefs, including Panepaoa, Ngāmoerangi, Rautoetoe, and Te Una.

We also discussed how Kuku Reef, once part of Ngāmoerangi, boasts beautiful kuku where the awa becomes one with the moana — Tangitū, Te Matau-a-Māui, and Te Moana-nui-a-Kiwa.

Strong themes that emerged included the desire to:

- strengthen our connections through space and time to Te Taiao
- understand more and pass on mātauranga tuku iho, including tikanga, to our tamariki
- revive expressions of cultural values through established and new compositions (e.g. pao, haka, waiata, mōteatea, karakia and takutaku to heal)
- go to the moana more often with tamariki
- be even more active kaitiaki and uphold tino rangatiratanga, and active protection of taonga.

The kōrero and themes from this and other wānanga informed the project goals (see summary Table 1 page 112). The Tirohanga Tohu – Observation Survey was developed to help strengthen our journey to reinvigorate mātauranga tuku iho and our connections to Te Taiao.

Recognising the discomfort that many of our kaumātua and whānau might feel in assessing mauri as part of He Kāinga Taurikura, viewing it as potentially disrespectful or reductive, we decided to focus future mātauranga 'assessments' on hauora. The Tangitū survey assesses hauora from the perspective of our kairuku.

Additionally, we identified the opportunity to record the current state of hauroa of our Hapū relating to Tangitū, to track our progress over the coming years. The Panepaoa Survey was drafted for this purpose.

Appendix B:
Summary of Goals and Perspectives

Table 1: Summary of the goals of this project and the perspectives of our Hapū, shared during wānanga and through the previous work of MTT.

Summary of goals and Hapū perspectives for He Kāinga Taurikura o Tangitū	
Ngā mātāpono – **some Hapū values relevant to Te Taiao**	• Whakapapa • Mana & Tino Rangatiratanga • Kaitiakitanga, Manaakitanga • Tauutuutu
Ngā mātāpono – **MTT shared values have guided this project**	• Pūmau te Wairua - Spiritually strong • Tuakiri Motuhake - Strong identity • Oranga Ngākau - Wellbeing • Whānaungatanga - Strong relationships • Te Piri Ngātahi - Unity • Whai Hua - Progressive
Whāinga – **Hapū goals:**	• Mātauranga tuku iho and cultural values are reinvigorated – Haere ki ngā wāhi taonga, kia ako, kia rongo, i te wairua, i ngā tohu o Te Taiao, arā, i ngā kihi maitai. *(Go to wāhi taonga to learn, connect to atua, to feel, sense, the signs of Te Taiao, the murmurings of the moana.)* • Kuku Reef and Tangitū are healthy and taonga species thrive. • Kuku are safe to eat. • Kuku are plentiful – sustainable for our future generations. • Well-informed decision making that is Te Tiriti compliant.
What to monitor?	Mātauranga tuku iho, cultural values and taonga including: • Hapū knowledge and use of mahinga kai, related taonga tuku iho and cultural practices. • Safety of kaimoana, rongoā, and the wai for our tinana. • Kaimoana size range and numbers. • Taonga species especially kaimoana, rongoā and manu.
Who needs to be involved:	Tangata whenua / whānau need to be actively involved in cultural-environmental monitoring and restoration of Kuku Reef (e.g. undertaking monitoring, recording the insights from customary take, taking photographic records, planting etc).
Where:	Specific wāhi taonga (including mahinga kai) that have supported various Hapū cultural values have been mapped and described in various wānanga and documents, including MTT records, evidence, and books (Colenso 2019; Gray 1996; Guthrie-Smith 1926, 1953, 1969; Hiha 2016; Hopmans 2016, 2022; Lucas 2020; Maungaharuru-Tangitū Hapū et al. 2013; Maungaharuru-Tangitū Society Limited 1996; Maungaharuru-Tangitū Trust 2015, 2016; May 2011, 2012, 2022; Parsons 1993, 1997; Pishief 2020; Puna 2022; Reti 1993, 1996, 2006, 2016; Taurima, A 2022; Taurima, H 2016, 2022; Taylor 1993, 2006, 2016, 2020, 2022; Waitangi Tribunal 2004; Walzl 2020a, 2020b).
When:	Ideally timing for monitoring would be guided by whānau knowledge holders to align with our maramataka, our whakatauākī, seasonal use of various taonga species and mahinga kai, and after events such as heavy rainfall.
Data collation, analysis and reporting:	Given the significance of whānau knowledge and mātauranga tuku iho in designing and delivering the Hapū Implementation Plan, we recommend that data collation, analysis, and reporting be managed by MTT with support from partner agencies. This approach should align with the principles of Te Mana Raraunga (2018), ensuring that data sovereignty and the protection of Māori data are prioritised throughout the process.
Outcomes sought from use in decision making:	To build lasting solutions for a healthy Tangitū, Kuku Reef, and kuku, it is essential to gather information that complements a mātauranga-led approach to cultural-environmental monitoring, restoration, and improved management practices.

Appendix C:
Mātauranga tuku iho and cultural values are reinvigorated

Being active kaitiaki

Haere ki ngā wāhi taonga, kia ako, kia rongo

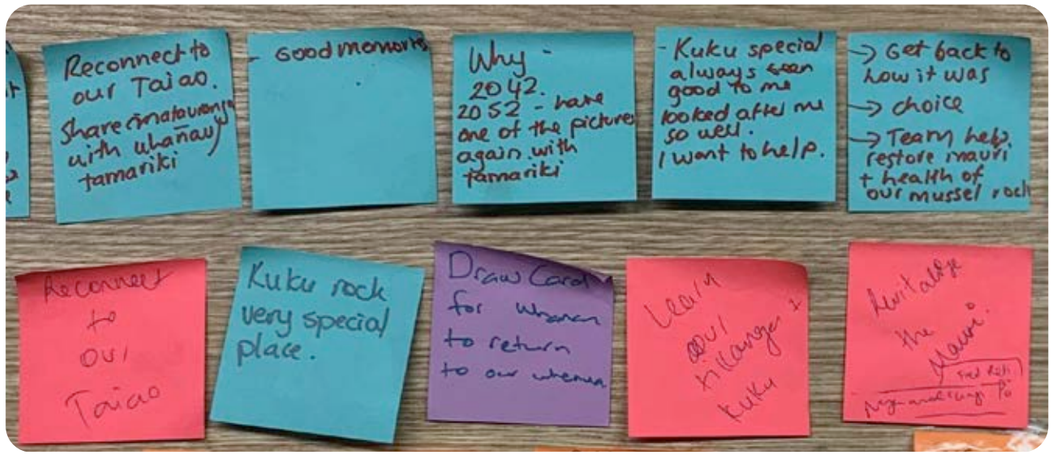
- i te wairua
- ngā tohu o Te Taiao
- arā, ngā kihi maitai

Go to wāhi taonga to learn, connect to atua, to feel, sense, the signs of Te Taiao, the murmurings of the moana.

From the wānanga there was a strong desire to reinvigorate our mātauranga tuku iho, create new mātauranga, be more active and present with our whānau, tamariki, mokopuna at our mahinga kai and wāhi taonga, such as Kuku Reef. This will assist us to become more active kaitiaki.

Below are some aspirations from Te Tumu Tangitū:

- "privilege [to have] our mātauranga Māori – pass it on"
- "Reconnect to our Taiao, share Hapū mātauranga with whānau, tamariki"
- "learn our tikanga"
- "Revitalise the mauri"
- "Connection – be involved and do something about it"
- "[I want] my tamariki mokopuna to have the same childhood stories"
- "[to have] our kids collect kuku, know how and are safe"



Karakia

One of our tipuna whāea, Sally Taunoa, explained:

> "The old people would do a karakia before we left home, and we did our own when we got to the beach, and when we left the water. …. You got to thank him up above for giving our kai. And that way they look after you" (2008: 5).

She provided the following karakia

> "E Te Matua, Tama, Wairua Tapu,
> homai tō aroha kia mātau
> ki te haere, ki te tiki i ngā kaimoana.
> Homai tō aroha ki te piki ora."
> (2008: 5).

Whānau want to use relevant karakia when going to the moana, ngahere, awa. To assist our whānau who are at the earlier stages of the journey in te reo me ngā tikanga, our Hapū reo expert, Justin Puna, composed the following karakia.

These are intentionally simple so that they can be learned and accessible to many of our whānau, including tamariki. These karakia are to provide safe passage and to give thanks.

The fourth line of the karakia can be adapted to where in Te Taiao whānau are going. They acknowledge the realms of Tangaroa, Hinemoana, Tāne, Papatūānuku, Ranginui and Tāwhirimātea.

Marino tō, marino tokitoki, marino tukupu are all expressions for a nice calm day where the wind isn't blowing.

Karakia moana

Marino tō
Marino tokitoki
Marino tukupu
Kia āio piropiro ai a Hinemoana
Haumi e, hui e
Tāiki e

for use after collecting kaimoana:

Mānawatia a Hinemoana
Mānawatia a Hinekuku
Mānawatia a Pāuatere
Nā koutou i homai
e ngao ai ko ropi
e ora ai ko manawa
Tihei Mauriora

Karakia mō te ngahere / whenua

Marino tō
Marino tokitoki
Marino tukupu
Kia tau mai ko te tīare o te ngahere
Haumi e, hui e
Tāiki e

Karakia mō te awa

Marino tō
Marino tokitoki
Marino tukupu
kia āio piropiro te waimāori
Haumi e, hui e
Tāiki e

Tirohanga Tohu – Observation Survey

We designed a survey, Tirohanga Tohu, based on our wānanga, mātauranga tuku iho and guided by the maramataka. This survey helps to strengthen our relationship with Tangitū, by calling us together at Kuku Reef for a shared purpose. It also focusses our attention on the tohu of Te Taiao.

The survey form was created using ArcGIS Survey 123 software. It can be filled in on any type of phone / tablet / computer, online or offline (which is especially useful in remote areas).

The information our Hapū collect over time will grow our mātauranga and māramatanga, and alert us to changes in Te Taiao. An overview of the survey is provided below. We are open to sharing more of this kaupapa with other whānau, hapū, iwi, on request (as MTT resources allow).

Maramataka – Te Mata o te Marama

The maramataka guides us when to undertake the survey – during different seasons, and the appropriate moon phase. Our Hapū are currently revitalising mātauranga about the maramataka for our takiwā. We have looked to lunar maramataka from our wider iwi, Ngāti Kahungunu, for guidance. In particular, to identify the most appropriate days for us to observe tohu around Kuku Reef.

We planned to align with the Tangaroa moon phase as it is regarded as a highly productive time generally, but is especially connected to awa and the moana (Solomon 2022). Painting (n.d.) also notes that Tangaroa is a time when significant research progress can be made.

There are 14-16 maramataka from Ngāti Kahungunu published by Roberts et al. (2006). They vary slightly in when the Tangaroa phase begins, as shown in Table 2 below.

To be most confident of being in the Tangaroa phase for our takiwā, we recorded our observations on the 23rd or 24th day after Whiro, i.e. Thursday 17 November 2022 and Friday 16 December 2022.

Table 2: First Tangaroa day in Ngāti Kahungunu maramataka (Roberts et al. 2006).

First Tangaroa day after Whiro (new moon)	Number of Ngāti Kahungunu maramataka
22nd	1
23rd	6
24th	8
25th	1

Maramataka – Ngā Tohu

In addition to guiding us **when** to undertake the survey, the maramataka also reminds us **where** tohu need to be observed, as described in this whakataukī:

Tuia ki te rangi,
Tuia ki te whenua,
Tuia ki te moana.
E rongo te pō, e rongo te ao.

The whakataukī explains that the rangi, whenua and moana are bound together. There is whakatapatorutanga – triangulation of the tohu in each domain (Solomon 2022). The Tirohanga Tohu survey includes sections specifically for those domains:

- Ngā tohu o te rangi (signs in the sky including Te Huarere weather conditions)
- Maungaharuru: ngā tohu o te whenua (signs on the land)
- Tangitū: ngā āhuatanga o te moana (sea conditions)

Other related sections include:

- Ngā kīrehe (animals)
- Ngā paketai (what's cast on the beach)
- Ngā āhuatanga o te Awa (river conditions)
- Tāngata: ngā rangona (senses)

Examples
Some example questions are described below.

Ngā Tohu Whenua

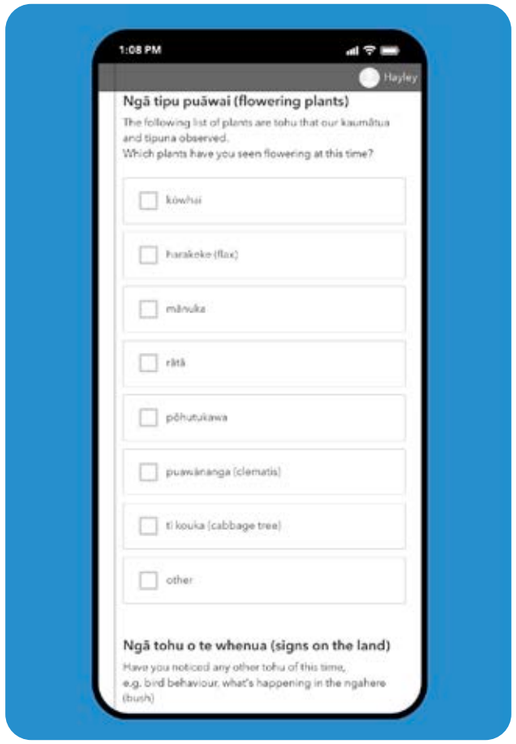
Our Hapū are reinvigorating our mātauranga relating to tohu in the ngahere on Maungaharuru, especially relating to manu. The tītī (Cook's petrel) and kōrure (mottled petrel) were harvested by our tīpuna but became locally extinct due to introduced predators. We are reintroducing these muttonbirds to Maungaharuru as part of the Poutiri Ao ō Tāne project. The timing of the arrival of adult seabirds, breeding behaviour, and fledging of chicks, are likely tohu that were important to our tīpuna (Wānanga 2022). The survey therefore includes space for this information.

Ngā Tipu Puāwai

Our mātauranga tuku iho tells us that tohu on the whenua signify when kaimoana is ready to harvest, especially particular tipu puāwai (flowering plants) (Walzl 2020a: 106).

Q) Our tīpuna used the timing of plants flowering as tohu (signs). Have you noticed any plants / trees flowering at this time?

A) āe (yes) / kāore (no) / aua (don't know)



Te Ngutuawa

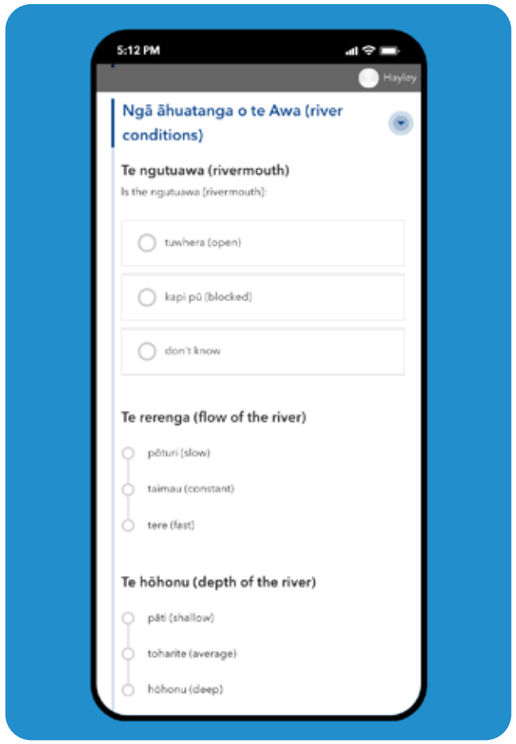
Te Ngarue and Pākuratahi join and flow onto Kuku Reef. The rivermouth occasionally becomes blocked with sediment. Our kaitiaki Tangitū (the whale), has the power to protect our Hapū, especially during natural disasters. She has been known to unblock the rivermouth using her tail, or to lie across it for protection during high seas (MTT 2013). The Regional Council reopens the rivermouth when there is risk of problems caused by upstream flooding or degraded water quality (Groves & Clode 2017). Therefore a question is included regarding the state of the rivermouth.

Te au o te moana ki Kirikiriroa

An experienced diver from our Hapū, David Puna, shared his mātauranga in an interview in 2008. He explained that by observing currents at a location closer to Napier city (where most of our Hapū now live) he could tell which area in our takiwā would have preferable diving conditions. David would watch the direction of currents from a rock at Westshore called Kirikiriroa. To help retain this mātauranga, it is included as a pātai in the survey.

Feeling in your puku

We have pūkenga in our Hapū with the ability to sense mauri. However, many of our whānau are not as comfortable discussing mauri (Wānanga 2018, 2022). Rather than attempt to assess mauri in the survey form, we instead have a pātai about how the kaitirotiro feel in their puku. The scale for the assessment has been adapted from Awatere et al. (2017), where we have replaced 'Aue' with 'pāmamae' and 'pōhara' with 'pōuri'.



Using mātauranga tuku iho to assess hauora

The next set of goals identified in this project are:

- Kuku Reef and Tangitū are healthy and taonga species thrive.

  "Revitalise the Mauri" "Kuku Rock is a very special place" "[We want there to be] diverse marine life"

  Te Tumu Tangitū member

  We want to fulfil our kaitiaki responsibilities to our tīpuna who provide for us. Our own wellbeing is intrinsically linked to theirs.

- Kuku are safe to eat.

  "Kuku are on the table of whānau and [at the] Marae" Te Tumu Tangitū member

  Harvesting kuku is an important cultural tradition and a food source. Our whānau need to be able to collect and eat kuku without fear of getting ourselves or our manuhiri sick.

- Kuku are plentiful – sustainable for our future generations.

  "Future generations can enjoy what past generations have enjoyed"

  Te Tumu Tangitū member

  Many whānau who are in their 40s and above, have fond childhood memories of time spent at Kuku Reef with whānau. A strong theme from Te Tumu Tangitū was the importance of those traditions continuing for our tamariki, mokopuna and following generations. That kuku are plentiful and harvestable into the future.

Kuku Reef was formerly renowned for abundant sea life. However, when there is not enough kaimoana to provide our manuhiri with, we are unable to properly fulfil our manaaki obligations. We need kuku to be plentiful to deliver on our whakatauākī (Taylor 2016).

Ngā Arotake - survey tools

To assess these goals – the hauora of our mahinga kai at Kuku Reef – using tohu from our mātauranga tuku iho, we developed two more surveys (in addition to Tirohanga Tohu):

- Tangitū (mātauranga ā-kairuku)
- Panepaoa (mātauranga ā-Hapū)

An overview of each survey is provided in this report. We are open to sharing more of this kaupapa with other whānau, hapū, iwi, on request (as MTT resources allow).

Pātai Development

These surveys are informed by mātauranga tuku iho including kōrero from wānanga during this project. Some of the survey questions were developed following those designed in Tangaroa Tohu Mana, Tangaroa Tohu Mauri Marine Cultural Health Programme (Te Ohu Urungi 2021). For some pātai, the response scale was specified following other Likert-type scales (Vagias 2006).

Tangitū - Mātauranga ā-Kairuku Survey

This survey is targeted towards our Hapū divers, who have specialist knowledge and experience that is very valuable to our Hapū. It is called Tangitū because she was a renowned diver.

Maramataka

Our maramataka guides us **when** to undertake the survey, i.e. *Ka kati a Tangitū*, when the season for collecting kaimoana from Tangitū closes. Our Pou Tikanga, kaumātua Bevan Taylor considers Tangitū closed after around April (Taylor pers. comm. 2022). The survey reflects on activities during the previous open season.

Wāhanga – Sections

There are two main sections of the survey:

1) Hauora o Tangata Whenua – relating to collection of kuku

2) Hauora o Te Taiao – relating to kuku, Kuku Reef, Tangitū

Those sections are separated into 'taha', which are informed by Durie's model, Te Whare Tapa Whā (1984), i.e.

- Te Taha Hinengaro – knowledge relating to kuku
- Tinana – actions related to harvesting
- Whānau – whanaungatanga & manaakitanga relating to diving
- Wairua – tikanga and spirituality relating to the moana

Example Questions

The are questions rating the health and condition of kuku, the kuku population and Tangitū more generally. Some examples of more specialised questions are described below.

Whanaungatanga

Members of Te Tumu Tangitū have reminisced about collecting kuku as a whānau, as tamariki with their grandparents, siblings, cousins. We ask pātai to know if that still happens and if knowledge is being passed down.

Q) In the past year, when collecting kuku at Kuku Reef, how often are you with less experienced whānau / tamariki / rangatahi to pass on your knowledge?

A)
1 never
2 rarely
3 sometimes
4 often
5 always
(Vagias 2006)

Tikanga

We are interested to know to what extent our whānau still follow tikanga that we have heard about in interviews and more generally.

Q) Do you follow tikanga when on / near the moana?

Such as: karakia, waiting till everyone is out of the water to eat kaimoana, try to always face out to sea, try not to shout or swear, other?

Taonga Species

There are pātai around species that are taonga to our Hapū:

Q) In the past year, how often do you see these taonga when out on Tangitū?

tohorā (whales), makī (orca), ā (dolphins), kekeno (seals), mangō (sharks), whai (stingray), diverse fish life?

Awa and Ngutuawa

The Pākuratahi and Te Ngarue rivers share the same rivermouth, which washes onto Kuku Reef. The use of land upstream impacts the water quality of the rivers, and therefore affects the kuku. We ask our divers some specific questions, and to rate the overall health of the water at Pākuratahi, Te Ngarue and the Rivermouth.

Q) How would you describe the water quality?

A)

1 pāmamae (hurt)
2 pōuri (sad)
3 āhua pai (ok)
4 pai (good)
5 pai rawa (very good)

Photo: Underwater scene at Punakērua; Leigh Tait, NIWA.

Panepaoa - Mātauranga ā-Hapū Survey

This survey is important in monitoring the hauora of our wider Hapū relating to Tangitū.

It is the result of kōrero coming from wānanga we held in November 2022. Participants expressed a strong desire to strengthen their mātauranga relating to Tangitū, and the opportunity for new compositions based on kōrero tuku iho, i.e. karakia, tikanga, whakapapa, waiata, mōteatea, pūrākau (Hapū history), maramataka, and rongoā.

As this survey is about our Hapū more generally, it can be answered by a small group of well-connected active Hapū members / MTT kaimahi. This survey is called Panepaoa, named after a small hill that looks over Kuku Reef but is not in the moana (shown in this picture).

Another purpose of this survey is to monitor the success of initiatives such as wānanga to increase knowledge of taonga tuku iho and interactions with Tangitū, within our Hapū.

This survey is also sectioned into 'taha' informed by Durie's model, Te Whare Tapa Whā (1984), i.e.

- Taha Hinengaro – knowledge of taonga tuku iho connected with Tangitū
- Tinana – active involvement in kaitiakitanga of Tangitū
- Whānau – whānau activities relating to Tangitū
- Wairua – connection to Tangitū for healing

Example Questions

We want our whānau to be actively involved in kaitiakitanga. This project itself and any future Hapū monitoring and survey activities will increase activity, and we want to measure that.

Q) How satisfied are we at the level of active involvement of our Hapū in kaitiakitanga of Tangitū?

i.e. activities such as those listed below:

takutaku / karakia, connecting with Tangitū, reading kaitiaki communications, attendeding kaitiaki hui, attending Hearings, sharing kaitiaki info with whānau, speaking with the public to educate them, picking up rubbish on the beach, reporting rubbish issues, reporting poaching, opposing consent applications

1 pāmamae (hurt): very dissatisfied: little to no involvement
2 pōuri (sad): dissatisfied: very few whānau involved, strong desire for others to be more involved
3 āhua pai (ok): neither satisfied or dissatisfied: some whānau very involved, some whānau occasionally involved
4 pai (good): satisfied: many whānau often involved
5 pai rawa (very good): very satisfied: many whānau of all ages involved at every opportunity

Many of our whānau feel spiritually uplifted by the moana. We have been careful in the wording of pātai as whānau use different ways to express this. Some of our pūkenga have 'pure' whereas others would say it just makes them feel better, at ease, peaceful. We want to understand how connected our Hapū is to that healing.

Q) How connected are our whānau to the moana, to go there to feel better, whakapurenga (purification ritual), or other healing purpose?

1 whānau don't go to the moana for healing
2 a few whānau occasionally go to the moana for healing
3 many whānau occasionally go to the moana for healing
4 most whānau regularly go to the moana for healing
5 all whānau often go to the moana for healing

Hauora Visualisation Tool

We conceptualised a visualisation tool during this project. It builds on whakaaro from previous wānanga, and is recommended to be part of the next phase of development for the overall He Kāinga Taurikura – Cultural Environmental Assessment Framework.

The takarangi could be used to visualise hauora assessment informed by mātauranga tuku iho. Our Pou Tikanga and Tohunga Whakairo, Kaumātua Bevan Taylor, offered the takarangi as a tohu for cultural-environmental assessment (Taylor, B. pers. comm. 2018). He explained that the takarangi is the

> "beginning of life... Rangi and Papa when they were joined together... Right in the centre is like a seed, the unborn, and as it spirals out ...the world of Rangi and Papa multiplied."
>
> (Taylor, B. pers. comm. 2018).

We are descendants of ngā atua (Taylor 2006). The takarangi represents our whakapapa to ngā atua, and therefore our connection to Te Taiao.

We digitised a takarangi carved in our Whare Tipuna, Punanga Te Wao:

The takarangi has two spirals. In the visualisation tool one spiral represents the hauora of Tangata Whenua, the other the hauora of Te Taiao, in relation to our mahinga kai – in this example, Kuku Reef, which is in the centre. The pākati – three joining features – remind us of the interconnectedness of the aronga in the waharoa framework – Tangitū, Maungaharuru, Tangata Whenua. The pātaki point is focussing towards the centre. This signifies putting all our knowledge into the central focus – in this example, Kuku Reef.

Taha

Four taha are assessed for each spiral. The taha assessing hauora of Tangata Whenua are informed by Durie's model, Te Whare Tapa Whā (1984).

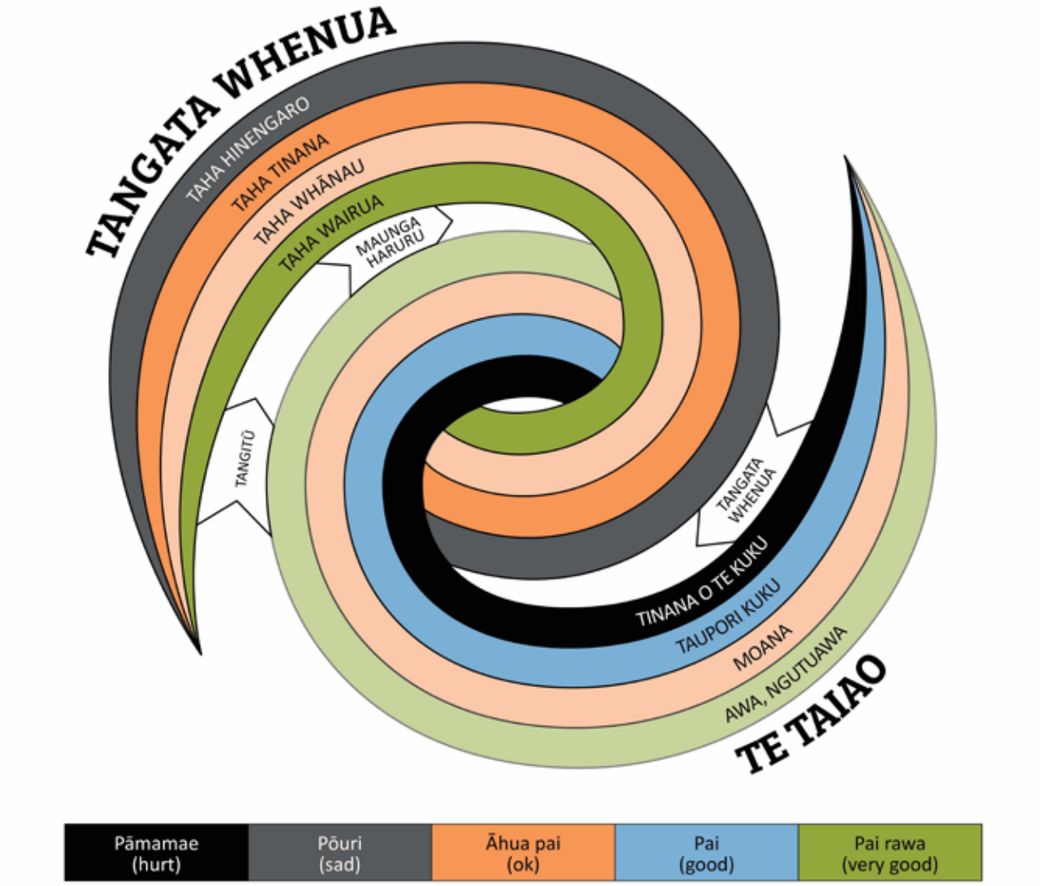
Taha assessing the hauora of Tangata Whenua:

- Taha Hinengaro
- Taha Tinana
- Taha Whānau
- Taha Wairua

Taha assessing the hauora of Te Taiao, Kuku Reef:

- Tinana o te Kuku (Kuku condition)
- Taupori Kuku (Kuku population)
- Moana
- Awa, Ngutuawa

The state of each taha is shown using a coloured line corresponding to the scale. The colours chosen for our scale were influenced by the Tihei-wa Mauri Ora construct (Pipiri & Body 2010) and Te Ara Maurea, which is part of The Mana Ora Framework for wellness (Tamaariki & Booker 2022).



The shade of each section indicates whether hauora is improving (strong colour) or declining (faded colour). For example, in the image above:

- Taha Hinengaro is grey, pōuri, so is in poor health. However, the colour is strong, so it is improving.
- Taha Tinana and Taha Whānau are orange, āhua pai, so are mid-range for hauora. The colours show that Taha Tinana is improving but Taha Whānau is declining.
- Taha Wairua is green, pai rawa, so is in great health.

Taha scoring

Table 3: Taha assessment using tohu:

TANGATA WHENUA	
Taha	Tohu
Taha Hinengaro	Knowlege of Mahinga Kai – Kuku: • maramataka & tohu • Taonga Tuku Iho
Taha Tinana	• Use of Mahinga Kai – Kuku • Active Involvement in Kaitiakitanga
Taha Whānau	• Whanaungatanga • Manaakitanga
Taha Wairua	• Practice of tikanga and kawa • Wairua

TE TAIAO	
Taha	Tohu
Tinana o te Kuku (Kuku condition)	• Observed Health & Condition • Level of concern re impact of pollution
Taupori Kuku (Kuku population)	• Size range • Numbers
Moana	• Overall Health of Tangitū
Awa, Ngutuawa	• Overall Health: Pākuratahi, Te Ngarue, Rivermouth

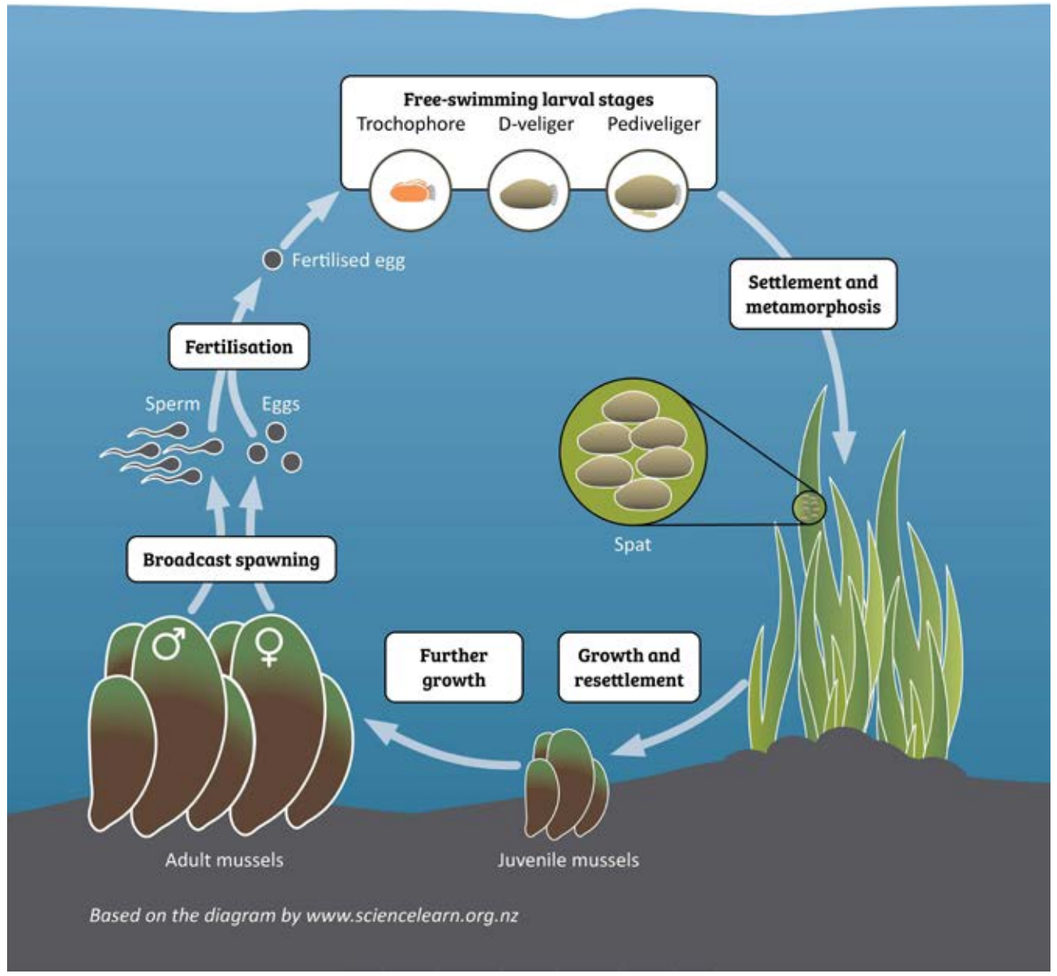
Tohu scoring

The tohu are assessed using the Tangitū Kairuku and Panepaoa Hapū Baseline surveys (described above). Tohu are scored by tangata whenua using pātai which are answered on scales from 1 to 5. This method was developed for the Cultural Health Index for Streams and Waterways (Tipa & Teirney 2006). This approach has been successfully incorporated into the Waitaki Cultural Health Programme (Tipa & Associates 2015), the Murihiku Cultural Water Classification System (Kitson et al. 2018), and Te Mauri o Waiwaia: A Maniapoto Freshwater Cultural Assessment Framework (Kaitiaki contributors et al. 2023).

The next phase would be to plan the implementation of tohu monitoring and develop a work plan to digitise and operationalise the Hauora Visualisation Tool.

The information our Hapū collect over time will grow our mātauranga, mōhiotanga (local practice based wisdom) and māramatanga (enlightenment), and alert us to changes in Te Taiao.

Appendix D: Kuku Life Cycle



Appendix E: Science-based marine monitoring approaches

During the wānanga within this project, Te Tumu Tangitū concluded that Hapū kaitiaki might face challenges in independently planning, carrying out, interpreting, and reporting on science-based marine monitoring. Therefore, collaborating with organisations is necessary for effective long-term monitoring. To guide the selection of approaches for the pilot field study, we developed a draft process which is subject to further refinement and validation.

Draft Process:

1. Collaborate with organisation(s)
    - Engage with relevant organisations to explore potential collaboration.
2. Define Goal(s)
    - e.g. Kuku Reef and Tangitū are healthy and taonga species thrive.
3. Resource Availability
    - Assess the availability of resources / funding opportunities including time, budget, and expertise.
4. Identify Indicators & thresholds
    - Determine key indicators to measure progress towards these goals. Use known thresholds or standards for each indicator to identify when they exceed a 'healthy' state.
5. Rationale for Selecting Specific Indicators
    - Understand why certain indicators were chosen, their relevance to the goals, measurement methods, and known thresholds to inform decision-making.
6. Develop Criteria
    - Establish criteria and assign weightings to assess the suitability of different monitoring approaches. These criteria should consider practical aspects and their importance to kaitiaki (Te Tumu Tangitū). The assessment involves specific questions, with some requiring yes / no responses and others rated on a scale. (See suggested criteria in Appendix F).
7. Preliminary Considerations
    - Scale: Determine which approaches are suitable for different cultural-environmental scales, such as individual kuku, Kuku Reef, or the wider area of Tangitū.
    - Use of Existing Data: Inquire with other organisations to determine if they are already monitoring relevant indicators.
    - Outsourcing vs. In-House: Decide whether tasks should be outsourced and assess if any science-based monitoring is accessible for the Hapū to do alongside the organisation.
    - Established Methods with Global Precedents: Prioritise methods with established global precedents and standard operating procedures.

Design and select methods

Carefully design the sampling methodology and select the appropriate sample substrate e.g.:

Choice of Methods: Select appropriate methods for the specific indicators being measured. For example, in-situ water testing, satellite data, or deploying buoy sensors can be used to measure water quality indicators. Each method has its strengths and limitations, and the choice should align with the monitoring goals and environmental conditions.

Type of Sample: Choose the correct type of sample (e.g. water, sediment, living organisms) based on the indicators and methodology. Consider the frequency and timing of sampling to accurately capture relevant data.

Accessing Sampling Sites and Resource Availability: Plan for practical details such as accessing sampling sites and ensuring efficient and consistent sample collection.

Develop Plans

- Develop a final survey design and cultural health and safety plans. Include required safety equipment, training procedures, and emergency response. Incorporate boat safety plans where applicable.
- Notify regulatory authorities (e.g. MPI compliance, airports if using aerial drones etc).
- Plan for engaging with whānau and other stakeholders throughout the process. Establish clear communication channels and feedback mechanisms to ensure inclusive and effective collaboration.

Pilot Study

Conduct the pilot field study and collect data using the chosen methods, ensuring accurate and consistent measurement of the identified indicators. Ensure that fieldwork photos are taken to visually document the process.

Analysis & evaluation

Analyse the collected data to assess the goal(s) and 'health' against established thresholds and evaluate the effectiveness of the monitoring methods.

Communication of results

Standardise templates for data analysis and reporting to ensure consistency and clarity in presenting findings. Utilise methods that communicate results in a way that specifically meets your audience's needs i.e. a Story Map summarising the results of this pilot field study.

Review, adjust and repeat sampling

Regularly review and adjust the monitoring process to improve methods and resolve issues. Implement repeated sampling over time to ensure the collection of more comprehensive and reliable data.

Appendix F: Criteria

Table 4: Suggested Criteria.

Paearu Criteria	Āta tirohia Assess	Pātai Questions	Aronga ake Weighting	Pūtake Rationale
Haumaru	Level of safety	Is specialist safety training required? (Āe=1, Kao=5) Is safety equipment necessary? (Āe=1, Kao=5) Level of other safety mitigation measures required (e.g. senior specialist presence, protective clothing, emergency procedures). (High=1, Medium=3, Low=5)	15%	H&S is crucial for the wellbeing of participants and affects who from the Hapū can safely use the approach.
Toitū Te Taiao (Environmental Sustainability)	Level of environmental impact	Level of environmental impact (High=1, Moderate=3, Low/None=5) Environmental concerns (e.g. pollution, habitat disturbance, resource consumption) (Many=1, Some=3, Few/None=5) Mitigation measures (e.g. eco-friendly materials, waste minimisation) (Few/None=1, Some=3, Many=5)	15%	Kaitiakitanga is at the heart of this kaupapa. Potential environmental impacts need to be weighed up against the benefits of the monitoring.
Whai Take	Usefulness	Number of relevant monitoring goals met, indicators measured (None=1, Few=3, Many=5) Other methods available to measure same indicator(s) (Āe=1, Kāo=5) Time and cost savings achieved compared to methods measuring the same indicator(s) (None=1, Some=3, Significant=5)	15%	An approach may score lower in other criteria but be the only option to measure an indicator, or one method may be able to measure multiple indicators, saving time and costs.
Tika	Level of accuracy	Percentage accuracy of data obtained (Low=1, Medium=3, High=5) Established methodology with global precendent (Kāo=1, Āe=5) Reliability rating (Low=1, Medium=3, High=5)	15%	Accurate and reliable data, along with expert analysis, is essential for credibility and future use, especially in legal contexts.

Paearu Criteria	Āta tirohia Assess	Pātai Questions	Aronga ake Weighting	Pūtake Rationale
Māmā	Ease of Use	Level of training required (Advanced=1, Intermediate=3, Basic/None=5) Standard operating procedures are available (Kao=1, Āe=5) Time involved to learn and operate the approach (High (years)=1, Medium (months)=3, Low (hours)=5) Level of difficulty (Very difficult=1, Difficulat=2, Neutral=3, Easy=4, Very easy=5; Vagias 2006)	10%	User-friendliness affects participation rates and inclusivity, advantages if rangatahi can participate.
Utu	Affordability	Initial acquisition cost (High=1, Medium=3, Low=5) Operating and maintenance costs per year (High=1, Medium=3, Low=5) Cost of data analysis (High=1, Medium=3, Low=5)	15%	Cost-effectiveness impacts the Hapū ability to acquire, maintain, and frequently use the approach.
Whakakau	Ease of communication	Complexity of the data analysis required (Very complex=1, Intermediate=3, Very simple/None=5) Need for specialised visualisation tools (Āe=1, Kao=5) Level of difficulty to understand (Very difficult=1, Difficult=2, Neutral=3, Easy=4, Very easy=5; Vagias 2006)	5%	Easier communication of findings enhances usability, Hapū and community engagement.
Pārekareka	Enjoyment of participants	Participants will enjoy (Strongly disagree=1, Disagree=2, Neither agree or disagree=3, Agree=4, Strongly agree=5; Vagias 2006)) Participants will want to repeat ((Strongly disagree=1, Disagree=2, Neither agree or disagree=3, Agree=4, Strongly agree=5; Vagias 2006)) Rangatahi will be engaged (Strongly disagree=1, Disagree=2, Neither agree or disagree=3, Agree=4, Strongly agree=5; Vagias 2006))	5%	If enjoyable, more whānau are likely to be involved, motivated, and rangatahi more likely be engaged.
Āhuatanga	If the approach requires specific environmental conditions	Specific environmental conditions needed (e.g. weather conditions, time of day, seasonal requirements) (Very specific=1, Somewhat specific=3, Flexible=5) Limitations due to conditions (High=1, Medium=3, Low=5) Flexibility in timing (Not flexible=1, Somewhat flexible=3, Very flexible=5)	5%	Specific conditions can limit usability, impacting planning and implementation flexibility, especially at times / days chosen for alignment with the maramataka and / or logistical reasons.

Appendix G:

The following are brief descriptions of the selected approaches for the pilot field study.

Tangitū Scale:

Satellite data	**Description**
Brief description:	In the past two decades, earth-orbiting satellites have revolutionised environmental monitoring. These instruments provide daily imagery in some cases and are equipped with advanced sensors that can indirectly assess many physical and biological properties. For example, satellites are routinely used to measure sea surface temperature (SST), the concentration of phytoplankton, and the concentration of particulate matter (e.g. sediments).
Indicators measured:	Satellite imagery is particularly useful for measuring three main water quality parameters: sea surface temperature (SST), chlorophyll-a, and turbidity (or total suspended solids). While these indicators are not particularly informative on their own, when coupled with indicators of individual kuku or population health, they can help inform the large-scale drivers of change. These tools can indicate conditions with the potential to impact kuku. Key indicators measured: • Temperature: Measuring sea surface temperature (SST) helps track trends in climate change, such as marine heatwaves. Changes in SST reflect shifts in global climate patterns, which can have significant impacts on marine ecosystems. • Chlorophyll-a: This indicator measures the concentration of phytoplankton, the tiny microscopic algae that form the base of the marine food web and produce oxygen. Monitoring chlorophyll-a levels helps understand changes in the delivery and availability of this essential component of the marine ecosystem. • Turbidity: Turbidity measures how clear or cloudy the water is, caused by particles and sediments suspended in it. Monitoring turbidity trends helps identify sediment run-off or re-suspension, which can affect water quality and marine life health.
Requirements (e.g. equipment, training):	Experience and knowledge of the limitations and caveats of using satellite data are generally required to assess and interpret this data. However, online platforms, notably the SCENZ (Seas, Coasts and Estuaries New Zealand) platform (Pinkerton et al. 2023), provide a user-friendly interface for extracting and analysing satellite data, making it more accessible to a broader range of users.
Pros:	Obtaining the data from these methods is cost-effective and passive, as satellites continuously capture images (without requiring input or direction) and cover the entire coast of Aotearoa-NZ on a daily basis. Unlike moorings, satellites can help understand spatial variation (e.g. point source discharges from rivers) and can be used to assess areas where manually collected data is sparse or nonexistent.
Cons:	While these datasets provide unmatched spatial and temporal coverage, not all relevant characteristics of water quality can be determined via these methods. Contamination of heavy metals, bacterial indicators, and nutrient concentrations require targeted manual sampling for accurate quantification. The water quality parameters measured by satellites are determined indirectly, representing relative changes. Additionally, satellites require clear skies during daylight hours, meaning no data is available during storms or cloudy conditions.
Haumaru – level of safety	No safety concerns.
Toitū Te Taiao – Environmental Sustainability	Little to no direct environmental impact.
Whai Take – usefulness	Very useful for identifying broad conditions in the marine environment and trends in specific areas or regions. No other method can match satellite data in terms of spatial and temporal coverage. However, in situ water quality metrics are important for cross-comparison and validation. Satellite-derived metrics provide essential context for understanding why changes in other indicators may have occurred.
Tika – level of accuracy	Satellite data is accurate and robust for determining broad trends in several proxies for water quality. However, the robustness decreases when interpreting trends over small spatial and temporal scales.
Māmā – ease of use	The availability of specialist platforms has significantly simplified the use of this method. However, some familiarity with the online platforms is required for effective and efficient use.
Utu – affordability	The cost is very low, as most platforms rely on freely available satellite imagery. This tool can be utilised as needed, since satellites continuously capture imagery. Streamlined or automated workflows can also reduce the burden of data analysis.
Whakakau – ease of communication	Satellite data requires experienced users for valid analysis and interpretation. Communication and interpreting the results can be challenging, especially for those without specialised knowledge.
Pārekareka – enjoyment of participants	Examining the wider Tangitū region can be an interesting and enjoyable experience.
Āhuatanga – if the approach requires specific environmental conditions	Require clear skies during daylight hours, meaning no data is available during storms or cloudy conditions.

Kuku Reef Scale:

Underwater drone habitat mapping	**Description**
Brief description:	Underwater drones (Remotely Operated Vehicles, ROVs) are submersible camera systems operated by a surface pilot that provide fine-scale control of underwater cameras, enabling the pilot to get close to the seafloor and observe the organisms present. This capability allows for species-level identification and determination of relative abundance. The underwater drone's maneuverability also permits visual inspection of various complex topographies and, in some cases, can be used to recreate 3D models of the underwater environment (known as structure-from-motion or photogrammetry). Additionally, this maneuverability facilitates the observation of pelagic organisms, particularly fish, which are not easily observed with downward-facing towed camera systems. However, underwater drone systems can be difficult to operate in shallow depths where swell surge is strong and may struggle to cover large areas. With the right configuration, underwater droness can provide very high-quality and stable imagery of benthic communities, allowing for the determination of species diversity with much greater certainty than towed imaging systems. They can also be maneuvered in various orientations to view complex habitats. However, since these systems are generally self-propelled and powered, covering large areas effectively can be challenging. For this pilot study, a Boxfish© underwater drone was used to access rocky reef habitat that was not safe to survey with towed cameras (i.e. the reef was too shallow for the boat to approach). Shallow rocky reef areas were navigated using the Boxfish© and then extensively searched for populations of kuku. Where patches of kuku were found, high-overlap, close-proximity imagery was taken to create orthomosaic images. Orthomosaic images are composite images created by stitching together multiple photographs taken from different angles and positions to form a single, high-resolution image that accurately represents the area surveyed. This method provides detailed and accurate spatial information about the habitat and species present.
Indicators measured	These tools can be used to estimate the cover of major species or functional groups of plants / animals on the seafloor, provided scaling lasers or other scaling methods are used. They can be used to cover moderate scales (e.g. 100's – 1000's of m^2). Key indicators measured: • Kuku cover • Species diversity – Predator and competitor cover / abundance • Habitat availability – Habitat cover metrics
Requirements (e.g. equipment, training):	An underwater drone requires access to a vessel of suitable size to deploy and manage it, as well as the use of a boat and specialist training or experience. Underwater drones typically have a live camera feed and can record continuous video and / or take still images. For habitat survey purposes, they are generally equipped with "scaling lasers", which enable the estimation of the size of objects and organisms. They can also be outfitted with lights and additional instruments for measuring water quality parameters. Underwater drones are connected to the surface by a cable. Additional equipment and training requirements include ensuring the vessel is equipped with a winch if necessary, and that the operators are trained in navigation, control, maintenance, safety protocols, and data management. Support equipment, such as computer systems for real-time data analysis, spare parts, and repair kits.
Pros:	Provides good manoeuvrability, cost-effectiveness compared to deploying a field team including divers, and the ability to cover very large areas. It is also suitable for use in places or circumstances where deploying people is unsafe.
Cons:	Can be difficult to deploy over complex terrain. Specialist training is required. Typically require vessels with a davit and winch for lowering and retrieving.
Haumaru – level of safety	The need to be on or around the water comes with the usual range of safety considerations. Any activities near the water should be carried out with the utmost caution, and participants should include flotation devices, throw ropes, and first aid kits in their equipment. Additionally, boating activities should include extra safety plans and equipment, such as flares, EPIRBs, and UHF radios. However, the ability to view the seafloor without entering the water eliminates many major health and safety concerns associated with SCUBA or freediving.
Toitū Te Taiao – Environmental Sustainability	Requirements for a vessel have an impact on carbon emissions, but the equipment itself can be used with little disturbance to the seafloor.
Whai Take – usefulness	Underwater drones provide similar products to Tow cameras and get quality stable imagery that enables additional metrics related to density and population size structure to be measured.

Tika – level of accuracy	Underwater drone imagery taken over sections of rocky reef habitat can be converted to a series of still images and then “stitched” together using “structure-from-motion” software to create an orthomosaic. From each orthomosaic and video, benthic species and fish can be identified (to genus or species where possible). Like any camera-based survey, the confidence in accurate results is high. Since photographic evidence is directly interpretable such results are highly applicable to legal proceedings. However, as with any method, rigorous analysis and good replication is required for defensible science. Additional lines of evidence will be important for interpreting trends.
Māmā – ease of use	More challenging to set up and use than most tools. Experience and training are necessary to ensure that the underwater drone is used appropriately. Participation by observers is possible in some situations with active oversight from experienced pilots.
Utu – affordability	There is a range of underwater drone products available, costing from a few thousand dollars to several hundred thousand dollars for highly specified models. Key features for obtaining good imagery include a high-resolution camera system, a strong propulsion system, and a reliable control system. The initial investment in equipment, as well as undertaking surveys and analysis, can be expensive.
Whakakau – ease of communication	Pictures and videos provide a great mechanism for communicating complex ideas and major changes between surveys can be directly visible to anyone.
Pārekareka – enjoyment of participants	Many people are fascinated by the underwater world, and these tools can provide excellent footage of the diverse marine life. While operating them can be enjoyable, it does require a certain level of training.
Āhuatanga – if the approach requires specific environmental conditions	For any underwater based survey optimal conditions include moderate to low swell conditions and clear water.

Kuku Reef Scale:

Towed or Drop camera underwater habitat mapping	**Description**
Brief description:	Drop or towed camera systems have been used extensively worldwide and are especially useful for covering large areas quickly. Since these instruments lack propulsion systems, they must be towed or moved by a vessel. There are large systems designed for deployments up to 7 km deep, as well as smaller, lighter versions that are suitable for shallow water. Affordable solutions can be assembled using GoPro™ cameras, coaxial cable, a heavy weight, and a tablet. However, deploying towed or drop camera systems over uneven terrain, such as patchy rocky reefs, can be challenging. These systems may also struggle to capture the high-quality imagery needed to determine small-scale indicators like plant and animal density and population size structure, especially in areas with turbid water. Towed or drop camera systems typically have a live camera feed and can record continuous video and / or take still images. For habitat survey purposes, they are generally equipped with scaling lasers to estimate the size of objects and organisms. These systems can also include additional instruments for measuring water quality parameters. Like underwater drones, they are connected to the surface by a cable. However, unlike most underwater drones, the cable is much thicker and heavier, as it must support and tow the system, power the submerged camera and lights, and transmit the video signal to the surface. Operating these systems requires a person to monitor the live video feed, a person to manage the cable or winch (usually operated from a davit), and the vessel skipper.
Indicators measured	Towed or drop camera systems can be used to estimate the cover of major species or functional groups of plants / animals, provided scaling lasers or other scaling methods are used. They can be used to cover moderate scales (e.g. 100’s – 1000’s of m^2). Key indicators measured: • Kuku cover • Species diversity – Predator and competitor cover / abundance • Habitat availability – Habitat cover metrics

Requirements (e.g. equipment, training):	A submersible camera system is required, as is access to a vessel of suitable size to deploy and manage a camera system. Good quality off the shelf systems are affordable, and bespoke solutions can be even cheaper. Effective use of towed or drop cameras requires the use of a boat and specialist training or experience, especially in situations where a winch is required to lower and retrieve the instrument.
Pros:	Can be cheaper than deploying teams of people, can cover very large areas, and can be used in places or circumstances where people cannot be safely deployed.
Cons:	Can struggle to take high quality imagery in some situations, can be difficult to deploy over complex terrain. Specialist training is typically required, and technical challenges are often faced. Typically require vessels with a davit and winch for lowering and retrieving. Lack of viewing angle flexibility limits these tools to largely seafloor assessments.
Haumaru – level of safety	The need to be on or around the water comes with the usual range of safety considerations. Any activities in, on, or near the water must be carried out with the utmost caution. Participants should include flotation devices and throw ropes and first aid kits in their equipment. Additionally, boating activities should include extra safety plans and equipment, such as flares, EPIRBs, and UHF radios. However, the ability to view the seafloor without entering the water eliminates many major health and safety concerns associated with SCUBA or freediving.
Toitū Te Taiao – Environmental Sustainability	Requirements for a vessel have an inherent impact on carbon emissions, but the equipment itself can be used with little disturbance to the seafloor. Because of wave driven movement there is a greater chance of coming into contact with the seafloor than for underwater drones.
Whai Take – usefulness	This method can be replaced by SCUBA divers or underwater drones. SCUBA divers can use hand-held cameras or perform quadrat / transect surveys. Drop cameras can be very effective at covering large areas but can struggle to get quality stable imagery that enables additional metrics related to density and population size structure to be measured.
Tika – level of accuracy	Like any camera-based survey, the confidence in accurate results is very high. Since photographic evidence is directly interpretable such results are highly applicable to legal proceedings. However, as with any method, rigorous analysis and good replication is required for defensible science. Additional lines of evidence will be important for interpreting trends.
Māmā – ease of use	Experience and training are necessary to ensure that towed or drop cameras are used appropriately, especially alongside vessel skippers who must manoeuvre vessels while being mindful of the tether. Participation is possible in some situations with active oversight from experienced pilots.
Utu – affordability	Initial investment in equipment is moderately expensive and surveys can be expensive to undertake. Can potentially be cheaper than underwater drone surveys but is definitely cheaper than SCUBA diving surveys.
Whakakau – ease of communication	Pictures and videos provide a great mechanism for communicating complex ideas and major changes between surveys can be directly visible to anyone. Footage from these tools can be less pleasing than underwater drone surveys as it can often be “jerky” and is typically facing down or forwards.
Pārekareka – enjoyment of participants	Many people are fascinated by the underwater world, and these tools can provide excellent footage of the diverse marine life. While operating them can be enjoyable, it does require a certain level of training.
Āhuatanga – if the approach requires specific environmental conditions	For any underwater-based survey, optimal conditions include moderate to low swell and clear water. However, since drop cameras are controlled from the surface, they are more constrained by swell height than underwater drones. Even small swells can make smooth operation difficult, as the camera will continuously move up and down in the water column with the waves. In shallow environments, optimal conditions are further constrained due to increased swell interference. Wind at the surface can also be problematic for the surface vessel, which must maintain a steady speed and direction.

Kuku Reef Scale:

eDNA metabarcoding from seawater

Description

Brief description:

All living things contain DNA that encodes the genetic instructions for their growth and functioning. Particular strands of DNA are unique to specific taxa (groups of related organisms) and species, allowing us to identify which organisms are present in an ecosystem from just their DNA.

Environmental DNA (eDNA) is DNA released from organisms into the environment. This can come from sloughed skin cells, faecal matter, reproductive material, decomposing remains, and, in the case of small animals, whole organisms (e.g. plankton). This approach was first used in the 1990s to identify toxic algal blooms and faecal contamination in water supplies. eDNA is now a powerful tool for obtaining species and ecosystem information in environments that are difficult or expensive to sample.

Strategies for marine eDNA sampling vary based on the goals of monitoring. The approach used in this pilot fieldwork was metabarcoding, which is a sensitive and widely used approach for species detection and biodiversity assessment. Biodiversity refers to the variety of life in a particular habitat or ecosystem. It includes the diversity of species, genetic variation within species, and the variety of ecosystems themselves. High biodiversity typically indicates a healthy, resilient ecosystem.

eDNA metabarcoding can detect the presence of a broad range of organisms spanning from whales to bacteria, including those that are cryptic, rare, or small, which might be missed by conventional methods such as visual surveys or physical sampling. This method involves amplifying and sequencing specific regions of DNA that are common across many species, enabling the identification of multiple taxa from a single sample of seawater.

However, metabarcoding comes with its own set of sampling demands and limitations. It requires careful consideration of DNA extraction and amplification protocols to avoid biases and ensure accurate representation of the community, and there are limitations in the resolution at the species level. Additionally, environmental factors such as water movement, temperature, and salinity can influence the detection of eDNA, necessitating careful planning of sampling locations and times. Determining the physical scale of eDNA sampling in a marine environment is complex and influenced by various factors, including local water mass movements, currents, environmental conditions, topography, and coastline features. Water mixes and moves in unpredictable ways, spreading eDNA over different scales. The volume of water filtered during sampling can provide a metric for estimating the sample scale, but it must be interpreted carefully.

In contrast, methods such as quantitative polymerase chain reaction (qPCR) or digital droplet PCR (ddPCR) assays are designed to target specific organisms. These techniques are highly sensitive and can quantify the abundance of particular species, making them ideal for targeted surveillance and monitoring of invasive species or pathogens (Wood et al. 2019). However, they do not provide the broad community insights that metabarcoding offers.

Indicators measured:

- Biological diversity – eDNA metabarcoding can accurately identify a wide range of species e.g. fish, marine mammals, zooplankton, phytoplankton, invertebrates, and bacteria. It also allows for the classification of organisms at higher taxonomic levels, such as genus (a group of related species) and family (a larger group of related genera).
- Functional group diversity – eDNA metabarcoding can be used to identify and categorise organisms based on their ecological functions rather than their taxonomic classifications e.g. the presence and diversity of functional groups such as primary producers (like phytoplankton), decomposers (such as bacteria), and various trophic levels of consumers (including herbivores, carnivores, and omnivores). This approach helps scientists understand the ecological roles different species play and how they contribute to the overall functioning and health of marine ecosystems.

Requirements (e.g. equipment, training):

This pilot project required eDNA sampling kits, a labelling kit and notepad. Participants require suitable health and safety equipment including footwear to sample at low tide from a rocky environment.

Pros:

Quick, easy and relatively cheap to sample, send for analysis, and obtain results. There are various providers in Aotearoa-NZ, including Wilderlab, Sequench, and the Cawthron Institute.

eDNA sampling provides a broader view of biodiversity compared to other methods. It can detect cryptic, rare, and small species that might be missed by underwater or aerial cameras or conventional sampling techniques. A single sample consisting of several liters of seawater can be used to conduct multiple assays, which are tests to detect and measure different taxa, or groups of related organisms.

Cons:

While eDNA is a relatively new yet increasingly established technology, it does come with limitations e.g:

- DNA Degradation: The DNA may degrade before it can be detected.
- Water Mass Separation: The DNA may not be transported to the sampling region due to water currents or separation. For example, currents may move eDNA fragments between regions, meaning eDNA originating from a large area may be sampled.

Cons (continued):	Conversely, coastline embayments may restrict water flow, so eDNA sampled in an embayment may only originate from within that specific area. • Database Limitations: The species' DNA identification information may not be available in current DNA databases. However, these databases are rapidly improving, and data can be re-analysed as they grow. • False Positives and False Negatives: A species may be present but not detected, or absent but falsely detected. This problem is not unique to eDNA and also occurs in conventional sampling methods. Non-detection is always a concern for rare or uncommon species in any survey. • eDNA does not provide information on the abundance of metazoans (multicellular organisms). The amount of eDNA detected does not correlate directly with the number of individual organisms present. For example, a single large organism can shed as much eDNA as many smaller individuals, making it difficult to estimate population sizes based solely on eDNA data. • Repeated sampling over time can help estimate the 'occupancy' of rare species for both eDNA and conventional methods. Occupancy refers to the proportion of sites where a species is detected out of the total surveyed sites. While a species might not be detected in every survey, repeated sampling increases the likelihood of detection and provides a better understanding of their prevalence. The more surveys conducted, the more accurate the picture of species presence and distribution becomes.
Haumaru – level of safety	The need to be on or near the water comes with the usual range of safety considerations. Any activities in, on, or near the water must be carried out with the utmost caution. Participants should include flotation devices and throw ropes and first aid kits in their equipment. In general, good risk management processes must be followed, including working with a buddy to spot waves. Wash hands after sampling. Wear gloves (provided in the sampling kit) while handling DNA preservative. Avoid contact with DNA preservation solution.
Toitū Te Taiao – Environmental Sustainability	Environmental impact of sampling is relatively low. There is plastic waste associated with the sampling kit and lab analyses. Gloves should be worn and care taken when using the preservative. Avoid any spillage into the environment.
Whai Take – usefulness	Provides a wide snapshot of biodiversity, but other methods can also provide similar biodiversity subsets.

Tika – level of accuracy	eDNA metabarcoding is still developing as a tool for biodiversity assessment and is most effective when verified alongside other survey techniques. Accuracy is improving, but potentially still low. It may be difficult to rigorously argue that shifts in species profiles, as determined by eDNA, are due to environmental stressors rather than natural seasonal or yearly variations. However, because eDNA sampling is less expensive than conventional biodiversity surveys using divers, building up a time series of sequences can help develop a better understanding of how to interpret the results.
Māmā – ease of use	Easy and quick for all ages to collect samples without specialist help. Species data interpretation requires care.
Utu – affordability	Medium cost depending on assays used. As an example see: https://www.wilderlab.co.nz/order $15 per kit, $160-300 for assays targeting different taxa
Whakakau – ease of communication	eDNA providers will supply a comprehensive list of all taxa and species identified in the eDNA samples. Interested parties can then pinpoint species of interest (e.g. reef health indicators, taonga species, kuku predators) after validating the presence or absence of these species through other monitoring methods.
Pārekareka – enjoyment of participants	It is easy and fun to take the samples and link them to the taxa lists obtained.
Āhuatanga – if the approach requires specific environmental conditions	Seawater samples should ideally be taken at low tide around Kuku Reef or using Niskin bottle collection from a small boat under conditions of low water turbidity. High suspended sediment concentrations can clog the filter used to capture eDNA, reducing the sample's effectiveness before enough eDNA has been collected. A Niskin bottle is a water sampling device that can be lowered into the water column while open to allow water flow through the chamber. Once at the desired depth (e.g. just above the seafloor for seawater sampling for eDNA), the device can be triggered to close the chamber and collect a sample of seawater from that specific depth. However, this method only samples a small volume of water, which can be a limitation. Alternative methods (not used in this pilot field study), such as passive samplers, pumps, or towed nets / filters, can sample a larger volume of water. Passive samplers, for instance, continuously filter water over time, which can provide a more comprehensive eDNA sample. These methods can be more effective in capturing a representative sample, especially in environments with high variability in eDNA concentrations (Govindarajan et al. 2023).

Kuku Scale:

Condition index	**Description**
Brief description:	The health and condition of kuku can be determined over time using a variety of indices. These are measures used to assess specific characteristics or conditions. The simplest indices measure the ratio between shell weight and tissue weight, while more detailed indices assess the condition of reproductive organs and quantify parasite load or other signs of infection. Combined, these indicators provide a comprehensive assessment of the health of individual kuku and help determine if populations are under stress.
Indicators measured:	Flesh-to-shell ratios can indicate a nutritional imbalance, where kuku lose condition relative to their shell size. This imbalance can result from various factors such as parasites, low food supply, stress, or spawning. Histology, which involves preparing microscope slides to assess the reproductive organs of kuku, can determine their reproductive fitness. Healthy kuku produce high numbers of eggs and sperm, while unhealthy kuku focus on growth and survival. Before flesh-to-shell ratios become unbalanced, kuku will reduce their investment in or reabsorb reproductive organs to conserve energy. These changes can be detected before a significant loss of tissue weight occurs. This analysis provides metrics like gamete count and tissue condition, offering information about the overall reproductive health of the kuku. Additionally, assessments of parasite and disease loads can help determine the overall health of kuku and their susceptibility to infection. Key indicators measured: • Kuku condition • Kuku reproductive fitness • Kuku infection Scale: At the individual kuku level (survey design will determine the number of kuku required for sampling).
Requirements:	For submerged kuku collection, necessary equipment includes tools for gathering the kuku and safety gear such as gloves, masks, and a first aid kit. Working in or around water requires careful consideration of safety measures. For dissection and sampling, a dissection kit with scalpels, forceps, and scissors is essential, along with a tissue / swab sampling kit and tissue preservation solution with containers for transport. Personal protective equipment (PPE) including gloves, lab coats, and eye protection is required for safe dissection and handling of tissues.
Requirements (continued):	Measuring the simplest indices involves using scales with ±0.1g accuracy to weigh the kuku, a process that can be performed quickly and easily. In some cases, determining the dry condition is more reliable, which would necessitate a drying oven set at 60˚C. For more intensive indices, access to microscopes, biological staining techniques, and equipment for preparing microscope slides is required. This equipment is used to assess the condition of reproductive organs and quantify parasite load or other signs of infection, providing a more detailed analysis of kuku health.
Pros:	The simplest methods are cheap, effective, and easy to use, making them suitable for application alongside kaimoana gathering. These simple indices, such as measuring the ratio between shell weight and tissue weight, are highly informative for detecting stress in kuku. Kuku length can also be measured simultaneously, providing further useful data. Histological analysis is more challenging to measure but can provide deeper insights into the reproductive health and overall condition of the kuku. These more detailed analyses help identify the underlying causes of stress and provide a comprehensive understanding of the factors affecting kuku health. This approach allows for efficient data collection without requiring specialised equipment for the basic metrics, while the more advanced techniques offer valuable supplementary information, contributing to a broader understanding of kuku health.
Cons:	The simplest indices provide no mechanism of determining the cause of poor condition, while the more intensive indices require specialist equipment, experience, and take longer to complete.
Haumaru – Safety	While there are few safety concerns with measuring condition indices (except for standard laboratory safety practices such as wearing gloves, washing hands after sampling and safe use of knives / scalpels), there are safety requirements for safe collection of kuku. Any activities in, on, or near the water should be conducted with the utmost caution. Participants should include flotation devices and throw ropes and first aid kits in their equipment. In general, good risk management processes should be followed including working with a buddy to spot waves.
Toitū Te Taiao – Environmental Sustainability	The collection of kuku has a very low impact if done carefully. Collectors should take extra care not to damage other kuku or disturb plants and animals, by moving thoughtfully over the rocky reef. However, it is important to note that destructive sampling can reduce the kuku population over time if there is no new recruitment.

Whai Take – usefulness	These data are very useful, if not essential, especially when collected regularly. They can help integrate other indicators to assess trends in kuku condition and identify potential drivers of change.
Tika – level of accuracy	Very accurate, but confidence in the results increases when additional metrics are gathered.
Māmā – ease of use	Very easy to perform, tamariki and rangatahi could be involved in 'shucking' (opening) and measuring, although shucking and collecting will require adults and close supervision.
Utu – affordability	Typically very cheap although additional metrics will increase costs. However, even a broad range of metrics will still be relatively cheap (especially compared to population level habitat mapping).
Whakakau – ease of communication	The data are relatively easy for scientists to interpret and communicate effectively. While it may not always be possible to determine why condition indices have changed in the short term, long-term data can reveal important trends and underlying drivers.
Pārekareka – enjoyment of participants	The process of collecting is fun, the weighing and note-taking could be a little repetitive.
Āhuatanga – if the approach requires specific environmental conditions	Collecting kuku should be done during low tides and avoided during stormy weather and large swells. Additionally, the conditions prior to collection can be analysed to understand the impacts of events (e.g. marine heatwaves, floods).

It is also important to highlight that marine toxic algae, specifically Paralytic Shellfish Toxin (PSP) testing could also be considered under this category.

PSP is one of the primary types of shellfish poisoning, occurring when shellfish ingest toxic microscopic marine algae. These toxins are tasteless, odourless and remain unaffected by cooking. In environments where this toxic algae proliferates, all shellfish may become contaminated.

While algae play a vital role in ecosystems, consuming toxic varieties can lead to adverse effects, including diarrhea, amnesia, and, in severe cases of PSP, paralysis and even death. It is recommended that Hapū kaitiaki stay informed through updates and warnings provided by the Ministry for Primary Industries, observe warning signs in affected areas, and seek medical assistance if symptoms arise after consuming shellfish.

Kuku Scale:

Kuku faecal coliform testing	**Description**
Brief description:	Coliform bacteria are found in animal faeces (e.g. humans, fish, livestock), land runoff, soils, and vegetation. In low numbers, they are considered harmless and can even aid in digestion and vitamin synthesis in the human body. However, high numbers of faecal coliforms, particularly in foods, can indicate the presence of potentially harmful microorganisms that can lead to sickness. Kuku should be collected, kept fresh, and cooled promptly before being sent to a certified laboratory for faecal coliform testing. If test results show high levels of faecal coliforms in the kuku flesh, they are deemed unsuitable for consumption. Kuku should contain no more than 2.3 *E. coli* per gram, or 230 *E. coli* per 100 grams, as specified by the Australia New Zealand Food Standards Code (Federal Register of Legislation – Schedule 27 – Microbiological Limits in Food).
Indicators measured:	Faecal coliform content is measured as the most probable number (MPN) per 100g of kuku flesh. The MPN is a way to estimate the number of bacteria in 100g of kuku flesh. Instead of counting each bacterium, which is very difficult, scientists use a statistical method. They take small portions of the sample, put them in a nutrient solution, and see how many of these portions grow bacteria. From this, they estimate how many bacteria are likely in the whole sample. It's like taking a few spoonfuls of soup, counting the number of chunks in those spoonfuls, and then estimating how many chunks are in the entire pot. This helps ensure that the kuku are safe to eat by checking if the bacteria levels are within safe limits. Key indicator measured: • Kuku infection – suitability for consumption Scale: At the individual kuku level (survey design will determine the number of kuku required for sampling)
Requirements:	Depending on survey design, approximately (12+ individual kuku) need to be collected at each site where testing is required and posted to a suitable licensed laboratory within a short time period.
Pros:	The methods are relatively cheap (~$70 a sample), effective, easy, and can be applied alongside kaimoana gathering. This metric is highly informative as to the consumption suitability of the kuku.
Cons:	No mechanism of determining the cause of poor condition without further data collection. Samples must be transferred to the lab within a short time period.

Haumaru – Safety	There are safety requirements for safe collection of kuku. Any activities in, on, or near the water should be done with the utmost caution. Participants should include flotation devices and throw ropes and first aid kits in their equipment. In general, good risk management processes should be followed including working with a buddy to spot waves.
Toitū Te Taiao – Environmental Sustainability	The collection of kuku has a very low impact if done carefully. Collectors should take extra care not to damage other kuku or disturb plants and animals, by moving thoughtfully over the rocky reef. However, it is important to note that destructive sampling can reduce the kuku population over time if there is no new recruitment.
Whai Take – usefulness	Very useful if not essential, especially if assessed regularly. These data could potentially help bring together other indicators to help assess the trends in kuku suitability for consumption around other potential drivers.
Tika – level of accuracy	Very accurate, but kuku should be cooled and sent to the laboratory as soon as possible (typically in sealed bags, separated from ice packing) after collection. Confidence in the results increases when additional metrics are gathered (e.g. histology).
Māmā – ease of use	Easy, just need to collect whole kuku, keep cool and send to laboratory for analysis.
Utu – affordability	Typically cheap (~$70 a sample).
Whakakau – ease of communication	Data requires careful interpretation but should be easy to communicate effectively. It provides an indication of whether a kuku harvest is safe to eat. However, identifying changes that make kuku less safe to eat can be challenging.
Pārekareka – enjoyment of participants	The process of collecting is fun.
Āhuatanga – if the approach requires specific environmental conditions	Collecting kuku should be done during low tides and avoided during stormy weather and large swells. Additionally, the conditions prior to collection can be analysed to understand the impacts of events (e.g. marine heatwaves, floods).

Funding provided by:

Ko Ngā Moana Whakauka – Sustainable Seas National Science Challenge,
Tangaroa Programme, Project T5
Te Kūwaha (NIWA National Centre for Māori Environmental Research)

Report:

He Kāinga Taurikura o Tangitū

Prepared by:

Hayley Lawrence (Kaikirimana Taiao, Maungaharuru-Tangitū Trust)
Kelly May (Marangatūhetaua; Marine Scientist, Te Kūwaha, NIWA)