Te Mana o Taiari : Kā Tohu te Taiao

Climate change indicators for the Taiari catchment

Workshop Report

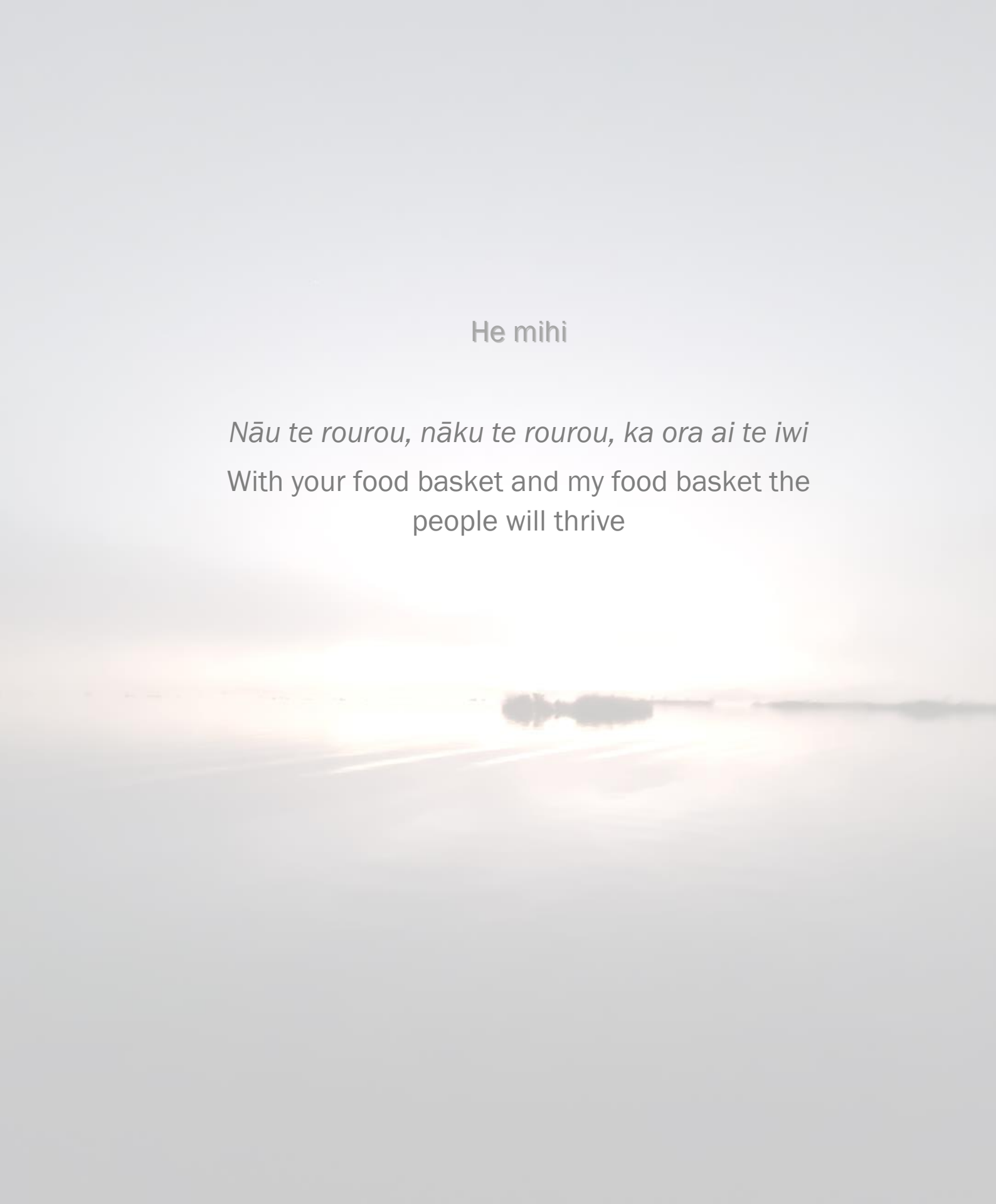
Prepared by
Shane Orchard

For
Department of Conservation
June 2023

He mihi

Nāu te rourou, nāku te rourou, ka ora ai te iwi

With your food basket and my food basket the people will thrive



Cover image: Waipōuri (Waipori) River
Back cover: Lake Waipōuri
Photo: S. Orchard

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CONTENTS

Executive summary

This report contributes to the development of Te Mana o Taiari Matatū ki te Taiao, a climate resilience strategy for the natural environment of the Taiari catchment in the Ōtākou / Otago region of Aotearoa New Zealand. The climate resilience strategy is being developed within the Ngā Awa river restoration programme co-led by mana whenua, the Department of Conservation Te Papa Atawhai and the Otago Regional Council. Its purpose is to address topics related to the potential impacts of climate change on the natural environment, and their integration with other climate and natural hazard considerations in the built environment.

The strategy development process began with an initial Hui Rautaki (strategy workshop) held on 11 June 2022 at Te Nohoaka o Tukiauau / Sinclair Wetlands. Results from that hui included the identification of an initial list of indicators for measuring change in the natural environment of the Taiari catchment. A follow-up Tohu Ruataki / Indicators hui was held on 21 May 2023. At this hui the list of potential indicators was considered further in relation to two key questions: their suitability as a tohu (indicator) of climate-driven changes, and the nature of potential information sources for their measurement.

The Tohu Ruataki / Indicators hui followed a focus group format with input from Te Rūnaka o Ōtākou, Kāti Huirapa Rūnaka ki Puketeraki, Department of Conservation, Otago Regional Council staff, Te Nukuroa o Matamata, and members of the local community. The characterisation of potential indicators was assisted by reference to the DPSIR (Drivers-Pressures-State-Impacts-Response) framework in which the key drivers include human wellbeing and resilience to climate change, and pressures include climate-related stressors. Indicators considered in the workshop were mostly aligned with the State and Impacts aspects of the DPSIR framework. The workshop process also considered the potential methods by which the associated metrics could be measured at appropriate spatial and temporal scales, and the forms and types of knowledge that might be used. At the conclusion of this process, the indicators that are more suited to measurement using quantitative methods were compared with others that might instead be approached using local and expert knowledge.

Indicators identified in the workshop included metrics related to key species, ecosystems and cultural values dependent on the natural environment of the Taiari catchment (see Table 1). Collectively, these indicators represent important values for management, but many are already degraded to some degree from the effects of previous development and land-use change. Consequently, there is an interaction between managing for climate resilience and the recovery of already degraded environments.

In upcoming stages of the resilience strategy process the indicators identified in this workshop will inform the design of baseline assessments and monitoring programmes to support Matatū ki te Taiao. They will also be incorporated within scenario analyses to investigate the potential impacts of climate change and identify tangible interventions to build climate resilience in support of Te Mana o Taiari.

Te Mana o Taiari - Matatū ki te Taiao

Climate resilience strategy for the Taiari catchment

Matatū ki te Taiao is a climate resilience strategy being developed by Te Rūnaka o Ōtākou, Kāti Huirapa Rūnaka ki Puketeraki, Department of Conservation Te Papa Atawhai, and Otago Regional Council. It contributes to Te Mana o Taiari, a catchment-wide restoration project within the national Ngā Awa programme established by the Department of Conservation in collaboration with mana whenua and community partners. As with other Ngā Awa projects, Te Mana o Taiari is applying a ki uta ki tai (mountains-to-sea) approach to restoring awa (river) environments through the identification, planning and implementation of new partnership and co-management models (Department of Conservation 2021).

Te Mana o Taiari aims to improve the mauri of the Taiari catchment by:

- Restoring ecological processes
- Enhancing native species diversity
- Increasing resilience to climate change

The strategy development process is addressing topics related to the impacts of climate change on the natural environment and their integration with other climate and natural hazard considerations in the built environment. The process began with an initial Hui Rautaki (strategy workshop) on 11 June 2022 at Te Nohoaka o Tukiauau / Sinclair Wetlands. Topics covered in that hui included discussion on a wide a range of risk and resilience concepts of relevance to natural resource management (Orchard 2022).

This report presents results from a follow-up hui with a focus on Kā Tohu te Taiao (environmental indicators). At this hui a list of natural environment values identified at the first Hui Ruataki was considered further in relation to:

- their importance as a tohu (sign) of climate-driven changes, and
- the identification of metrics and potential information sources for their measurement.

These two topics are interlinked and were discussed within the context of an interactive workshop session. This document summarises the discussion and findings from the workshop and has been prepared in collaboration with workshop participants and representatives from Te Mana o Taiari partner organisations.

Tohu Rautaki / Indicators workshop

The Tohu Rautaki / Indicators workshop was held on 21 May 2023 with input from Te Rūnaka o Ōtākou, Kāti Huirapa Rūnaka ki Puketeraki, Department of Conservation, Otago Regional Council, Te Nukuroa o Matamata and members of the local community. The workshop was conducted in two stages with the objective of the first stage being the identification of a short list of priority indicators using a local knowledge-gathering exercise, and the second being the identification of knowledge sources that could inform the measurement of those indicators. The workshop process followed a focus group methodology using a semi-structured expert elicitation format (Bryman 2004; Martin et al. 2012).

Tohu / Indicator framework

The DPSIR (Driving Forces-Pressure-State-Impact-Response) model was used as a framework for the indicator identification session (European Environment Agency 2005; OECD 2003; Smeets & Weterings 1999). Within the workshop process, the framework was defined and discussed by the

group using a hypothetical case of water abstraction (Figure 1). The DPSIR framework was interpreted for Matatū ki te Taiao by relating the driving forces to human needs in the context of climate change, and the pressures to climate-related stressors. The nature of these stressors had also been discussed in the initial Hui Rautaki workshop and these were further summarised and contextualised for the catchment based on the Otago Climate Change Risk Assessment (Tonkin & Taylor 2021) and a recent assessment of historical trends and downscaled climate projections (Goldsmith 2023). A summary of the key stressors considered in the Kā Tohu te Taiao workshop is shown in Figure 2.

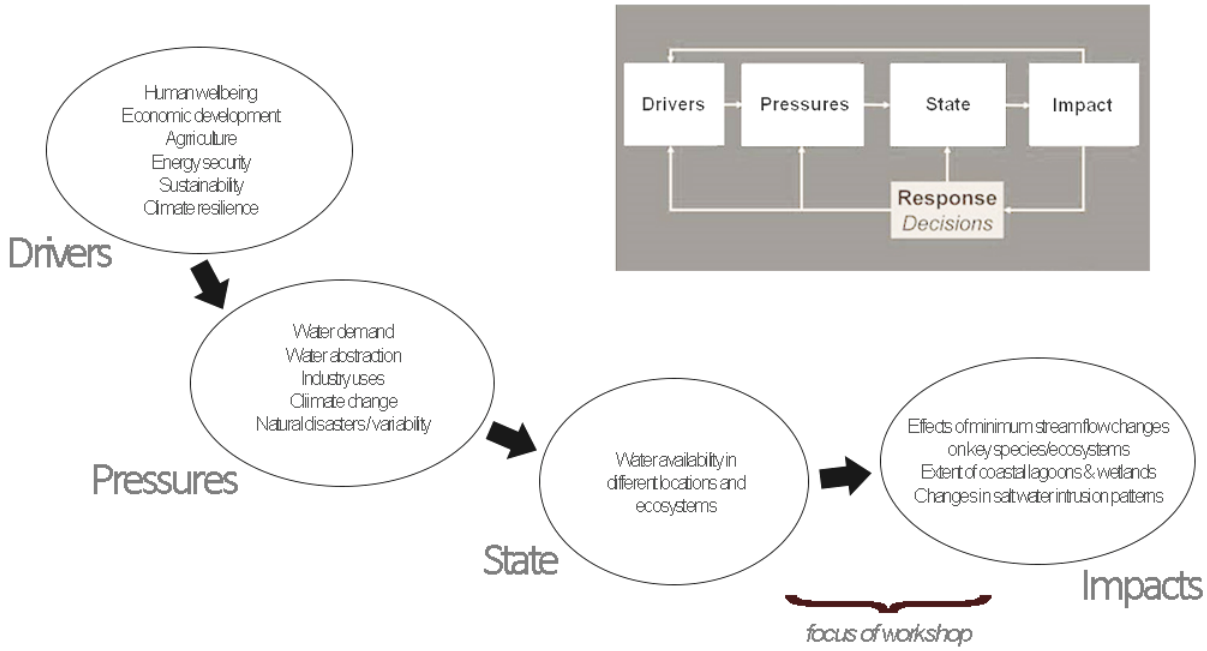

Figure 1 The DPSIR (Driving Forces-Pressure-State-Impact-Response) framework applied to a hypothetical case of water abstraction.

In the first part of the workshop, State and Impact indicators were identified for each of three major geographical regions within the catchment (Māniatoto, Strath Taiari, and Lower Taiari). The overall objective of this session was to identify and characterise a relatively short list of the most important indicators of environmental change. During this session, the metrics associated with each indicator were grouped under three broad categories (key species, ecosystems and cultural values dependent on the natural environment) as a means to further extend and develop a cohesive indicator set.

In the second part of the workshop, each group of indicators was discussed and further characterised in relation to the metrics by which they could be measured at appropriate spatial and temporal scales. This process also considered the different forms of knowledge that might be used by comparing indicators that are more suited to measurement using quantitative methods to others that might instead be approached using local and expert knowledge. This distinction was then extended to include a discussion of feasible approaches for estimating each indicator in climate change scenario analyses based on the known relationships between the indicator value and climatic stressors. This process was assisted by a summary of the key climatic stressors in the catchment based on the Otago Climate Change Risk Assessment (Tonkin & Taylor 2021) (Figure 2), a recent down-scaled assessment prepared for the Taiari catchment (Goldsmith 2023), and a worked example of a linkage between critical habitat for a taonga species (īnaka spawning grounds) and a climatic stressor (salt water intrusion) (Figure 3).

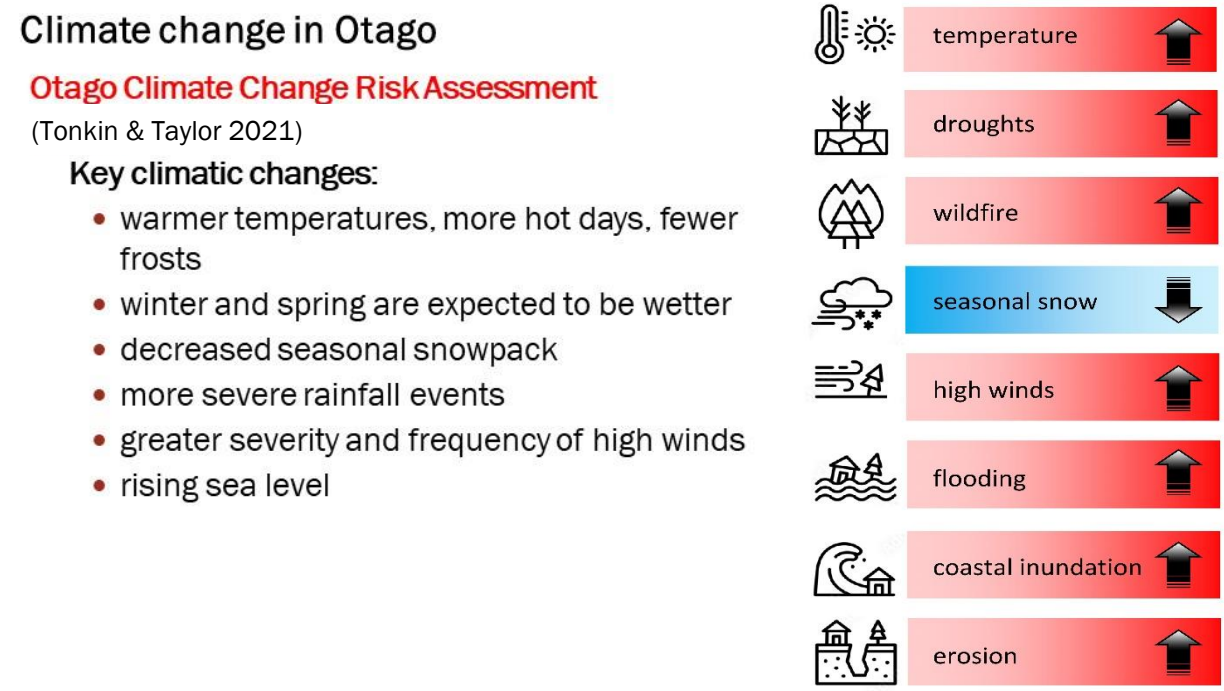

Figure 2 A graphical summary of the major groups of climate-related stressors predicted for the Otago region. Arrows depict the general trend in magnitude or frequency of the underlying entity in relation to current conditions based on information presented in Tonkin & Taylor (2021).

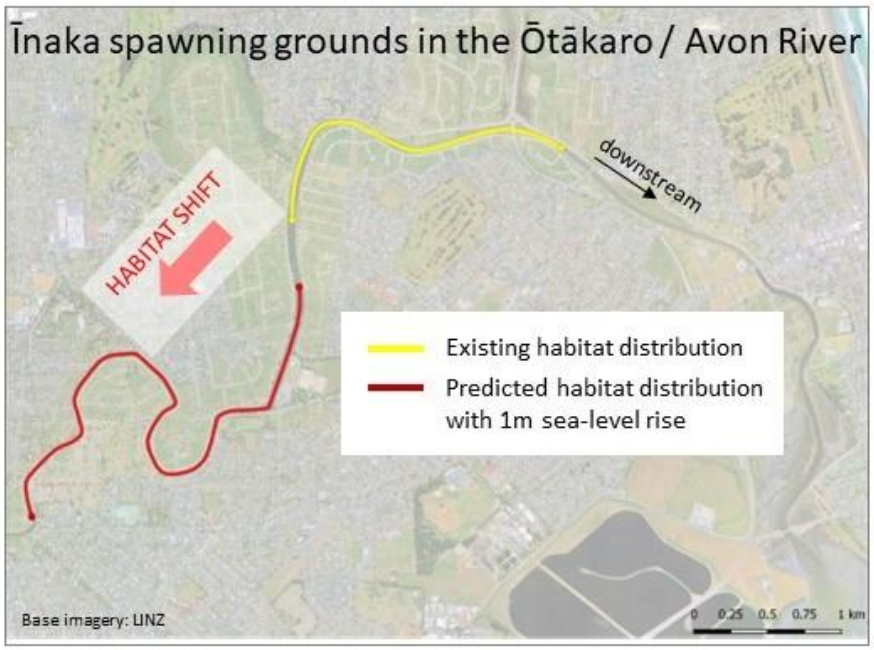

Figure 3 A worked example of a climate change scenario for a Tohu te Taiao (environmental indicator). In this case the indicator (īnaka spawning grounds) addresses the availability of critical habitat for a taonga species. The distribution of this habitat is expected to shift under the influence of sea-level rise (Orchard et al. 2018). The scenario presented shows an upstream shift of around 5.5 km in the Ōtākaro / Avon River that was developed using a hydrodynamic model of expected salinity conditions while also considering river flows (Orchard & Measures 2017).

The final stage of the workshop considered the logistics and implementation process by which the indicator metrics could be gathered to include spatio-temporal considerations such as the timing and frequency of measurements. This step also considered opportunities to build on existing projects, demand and capacity in the community through approaches such citizen science. The workshop concluded by summarising progress made in the session and identifying key directions and follow-up actions for the project partners.

Kā Tohu te Taiao / Environmental indicators

Indicators identified in the workshop were mostly aligned with the State and Impacts aspects of the DPSIR framework. Collectively, they represent natural environment values of importance to the local community and include a range of metrics related to key species, ecosystems and cultural values (Table 1). Many of the ecosystem indicators are applicable throughout the catchment (e.g., river morphology changes against a reference desirable state), but further work will be needed to define the reference state and appropriate sites, scales and techniques for measurement. In other cases, the indicator reflects a taonga species or habitat type that is characteristic of some parts of the catchment (e.g., non-migratory galaxiids, īnaka and kelp). In a complementary manner, indicators related to the various life stages of migratory species address both culturally-important mahika kai values and connectivity aspects inherent in the availability of key habitats at the necessary times. The selection of brown trout is notable as a non-native predatory species. Monitoring the shifting distributions of trout alongside that of native fishes was thought to offer the best overall approach.

The 2nd part of the workshop considered potential data collection methodologies and knowledge sources for the initial list of indicators. Table 2 presents a selection of the aquatic and riparian environment indicators grouped against three potential data sources (remote sensing, field surveys, and local knowledge). Although the specification of detailed methodologies was beyond the scope of the workshop, a range of technologies and approaches were discussed including modern and traditional fish capture methods, aqueous eDNA surveys, sediment core sampling, and the potential use of remote sensing approaches at various scales. Methodologies that may contribute to application of local knowledge were also identified including interview techniques such as those used in oral history studies, participatory mapping exercises and various forms of citizen science. These have the potential to contribute to data collection for several of the indicators and have the additional benefit of engaging the community in the kaupapa of the climate resilience strategy and wider restoration objectives of Te Mana o Taiari.

Table 1 A compilation of Kā Tohu te Taiao (environmental indicators) identified at the workshop for each of three major geographical zones in the Taiari catchment. Note that both aquatic and terrestrial indicators were recorded in this session.

Māniatoto	**Strath Taiari**	**Lower Taiari**
Ecosystem health measures: • Water temp / flow/ DO • 7 day MALF (mean annual low flow) • Wetland extent • Scroll plains function • Sediment load • Native plant cover – tussockland/ shrub/ forest cover • Fire regime in relation to desirable • Peatland condition • Algal biomass • Algal bloom frequency Population health of key species: • Skinks • Tuna • Non-migratory galaxiids • Weta Critical habitat measures: • Kanakana spawning grounds • Galaxiid spawning grounds • Connectivity change for migratory species Invasive species distribution: • Trout • Willows • Wilding pines	Ecosystem health measures: • Water temp / flow / DO • Frequency of algal blooms • 7 day MALF • Water levels in smaller tributaries • 1st order bogs / fen distribution • River morphology changes from desirable reference state • Frequency and extent of fires • Relationship between fire risk and recreational access • Gain/loss in native plant community cover Population health of key species: • Kanakana • Tuna • Non-migratory galaxiids • Weta Critical habitat measures: • Kanakana spawning grounds • Galaxiid spawning grounds • Connectivity change for migratory species Invasive species distribution: • Trout • Willows • Pigs / goats • Wilding pines	Ecosystem health measures: • Wetland extent • Riparian species composition (salinity marker) • Sedimentation rates • Carbon storage • Frequency of algal blooms • Frequency of fish mortality events Population health of key species: • Tuna • Giant kōkopu • Kanakana • Īnaka • Kākahi • Pātiki • Kelp • Penguins Critical habitat measures: • Īnaka spawning grounds • Penguin foraging grounds Invasive species distribution: • Trout
Cultural uses • Accessibility of river • Ability to be in / on the river • Recreational fishing catch • Availability and condition of resources for harvesting / mahika kai		

Table 2 A selection of Kā Tohu te Taiao (environmental indicators) for the Taiari river system, and potential mātauranga (knowledge) sources.

Indicator	Metrics	Potential data sources		
		Remote sensing	Field survey	Local knowledge
Ecosystem				
Wetland extent	Distribution / extent	✓	✓	✓
Riparian vegetation	Distribution / extent of characteristic vegetation types	✓	✓	✓
River morphology	Changes in channel form / bank erosion versus reference state	✓	✓	✓
Sediment accretion / erosion rates	Surface elevation changes in key deposition environments / habitat types	✓	✓	✓
Sediment size profile	Sediment composition change across key deposition environments / habitat types	✓	✓	✓
Taonga / key species				
Kelp species	Composition, biomass, distribution / extent	✓	✓	✓
Tuna elvers	Abundance (density), habitat distribution / extent		✓	✓
Inaka spawning	Habitat distribution / extent		✓	✓
Giant kōkopu	Abundance (density), habitat distribution / extent		✓	✓
Brown trout	Abundance (density), habitat distribution / extent		✓	✓
Kākahi	Abundance (density), habitat distribution / extent		✓	✓
Kanakana	Abundance (density), spawning ground & larval habitat distribution		✓	✓
Non-migratory galaxiids	Habitat distribution / extent		✓	✓
Pātiki	Abundance, size		✓	✓
Penguins (hoihō / kororā)	Foraging activity in river plume	✓	✓	✓
Cultural uses				
Recreational activities	Number of visitors / Frequency of use	✓	✓	✓
Nohoaka use	Mahika kai harvest		✓	✓
Nohoaka resources	Mahika kai availability in relation to traditional resources		✓	✓

He ara ki mua

The Tohu te Taiao (environmental indicators) discussed and refined in this workshop will help to inform the further development of a climate resilience strategy for the Taiari catchment. Some of the key ideas discussed in relation to climate risk, resilience, restoration strategies, and the role of indicators are summarised in Table 3.

Table 3 Summary of key discussion points from the Tohu Rautaki / Indicators workshop.

Topic	**Risk and resilience frameworks**
Discussion points	- A risk-based framework can help to build resilience • risk reduction create a practical focus for interventions • the assessment of risk (in this case climate risk) can support this strategy - The New Zealand Climate Change Risk Assessment (Ministry for the Environment (2019) uses a risk framework with three dimensions: hazards, vulnerability and exposure (Figure 2).
Topic	**Vulnerability concepts**
Discussion points	- Vulnerability involves the interaction between sensitivity and adaptive capacity - Adaptive capacity of ecosystems includes the role of people • positive relationships between people and natural environments, including active interventions, can increase adaptive capacity, thereby reducing vulnerability
Topic	**Climate change predictions for the Taiari catchment (presented by Mike Goldsmith)**
Discussion points	- For the Taiari catchment, pervasive climatic factors include precipitation and wind - These affect aspects such as erosion and sedimentation, wetlands, water quality and flows - Relative to current conditions and historical trends the pattern of expected climatic changes varies in intensity/ severity across the catchment • useful considerations for sub-catchment assessments and planning
Topic	**Role of indicators**
Discussion points	- Facilitate the assessment of risks to key values - Create a focus for identifying causal links between climate-driven physical environment changes and their impacts on natural environments / socio-cultural values dependent on them • metrics that can be measured and also modelled / simulated are useful for scenario analyses to investigate the potential impacts of climatic changes
Topic	**Application of indicators in resilience strategies**
Discussion points	- Conservation planning and prioritisation assessments • identify areas at most risk / in most need of active interventions - Future proofing of restoration strategies and sites • awareness of future change important to improve the longevity of restoration investments • support active restoration strategies that assist habitats and ecosystems to re-locate (e.g., along environmental gradients) in response to change

One of the central themes that emerged from the workshop discussion involves the interplay between restoration objectives and climate resilience in the Taiari catchment. Many of the underlying values represented by the indicators have already been degraded to some degree from the effects of previous development and land-use practices, and there is consequently an interaction between managing for climate resilience and the recovery of degraded environments. These are fundamental strategic considerations for achieving the restoration objectives of the Nga Awa programme. Important interactions for achieving recovery from degraded states include the need to understand the potential impacts of climate change on existing restoration sites, and conversely, identify new sites where active restoration work could assist dynamic environments to re-assemble in response to

environmental change. The removal of anthropogenic barriers to these natural habitat shifts forms an important class of restoration activities that can reduce the risk of 'habitat squeeze' as conditions change.

In the next steps for development of Matatū ki te Taiao, the indicators will generally be used to inform the design of baseline assessments and monitoring programmes to measure change over time. They will also be incorporated within scenario analyses to investigate the potential impacts of climate change. With regards to the latter, there was general agreement around the adoption of a local knowledge-based process for constructing and testing climate change scenarios, as opposed to a high degree of reliance on quantitative models. Co-designing the process for completing climate change scenario analyses will therefore form an important next step, and its implementation would be the primary mechanism for identifying resilience-building opportunities. Following this direction, the indicators reported here will help to frame and guide such a process, and the compilation of baseline data on their current status will provide further essential support.

A sequence of potential steps that summarises the overall direction of the strategy development process is shown in Figure 4. In this sequence, important future steps include integrating proposed interventions with other land-use and climate change adaptation considerations. It is likely that the best format for Matatū ki te Taiao will be a fluid, 'living' or 'evergreen' strategy that continues to evolve over time. Through this process it is hoped that tangible interventions that can increase climate resilience will be identified and implemented by the project partners in collaboration with the wider community of the Taiari.

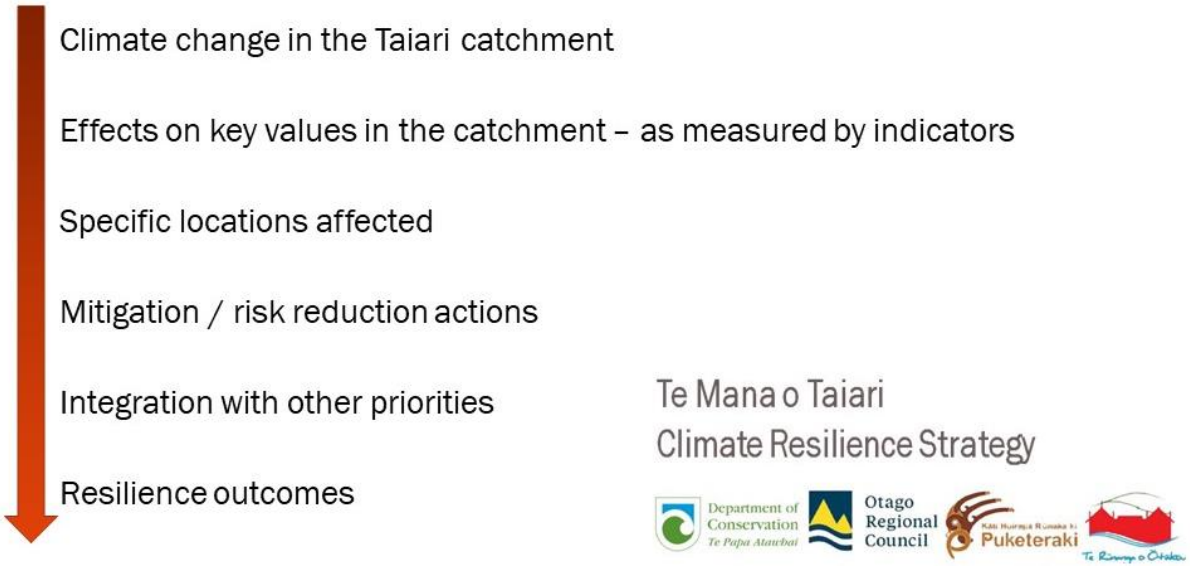

Figure 4 Overview of the strategy development process for Te Mana o Taiari Matatū ki te Taiao as discussed in the Tohu Rautaki (environmental indicators) workshop.

Acknowledgements

This report summarises the contributions of participants at the Tohu Ruataki / Indicators hui and acknowledges their expertise and knowledge of the Taiari catchment. The workshop was convened by the Department of Conservation Te Papa Atawhai with the support of Te Mana o Taiari partners Te Rūnaka o Ōtākou, Kāti Huirapa Rūnaka ki Puketeraki, and the Otago Regional Council.

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