Coordinated Monitoring of New Zealand Wetlands, Phase 2, Goal 2:
Maori environmental performance indicators for wetland condition and trend

A Ministry for the Environment SMF Project – 5105

Garth Harmsworth

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Maori environmental performance indicators for wetland condition and trend

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Phase 2 of the Coordinated Monitoring of NZ Wetlands Project was funded by the Sustainable Management Fund (SMF project 5105), Ministry for the Environment (MfE). The Phase 2 project July 2000–June 2002 was to provide nationally consistent indicators and tools for coordinated monitoring of wetland condition and trend in New Zealand. This work continued from that carried out in the Phase 1 wetlands project 1998–1999, which established wetland classifications and iwi relationships. The Maori component of Phase 2, to develop a set of Maori wetland indicators, began in October 2000, under contract to the Environmental Management and Design Division, Lincoln University, Christchurch.

Objectives

Phase 2 comprises four goals: (1) science-based indicators for wetland condition and trend; (2) a generic set of matauranga Maori based indicators for wetland condition and trend; (3) an illustrated field guide and key to the national wetland classification; (4) a handbook for managers. This report documents the work carried out in Goal 2: A generic set of matauranga Maori-based indicators for wetland condition and trend, which was separated into three main outputs 2a, 2b, and 2c:

- Output 2a: Record and identify a generic set of matauranga Maori-(iwi and hapu) based indicators for wetland condition and trend
- Output 2b: Field trial, verify, and calibrate Maori wetland indicators for national application
- Output 2c: Document final results.

Methods

It is important to develop environmental monitoring programmes that provide a balance in cultural perspectives and take into account other forms of knowledge for different parts, or strands, of the environment. This expanded knowledge base can complement scientific knowledge for environmental systems. Environmental monitoring methods in this report were therefore based on the following questions:

- How do Maori see their environment changing in time?
- How do Maori assess the state of health of the environment?
- What indicators do they use?
- There is a strong link between environmental change and Maori wellbeing. How can this be taken into account in environmental monitoring?
- How can Maori knowledge be used to underpin environmental monitoring?
- How can monitoring by Maori complement other approaches?

Methods included: understanding Maori concepts for environmental monitoring and indicator development; recording general Maori knowledge and values on wetlands; identifying and evaluating wetland information for indicator development; developing Maori methods for environmental assessment and SOE reporting by working with a number iwi and hapu representatives, researchers and kaitiaki communities. This work was carried out through participatory hui/workshops, field visits, discussion groups, and one-on-one interviews. Wetland indicators and assessment methods were field trialled, verified, and calibrated for national application at selected wetland sites in the North Island and South Island. All methods and results were documented and disseminated for comment.

Results

Maori indicators are a tohu or marker in time used to assess how Maori see their environment changing. The work in this report provides a method that Maori organisations can use themselves to assess environmental change and prepare state-of-the-environment reports, or generate results that can be passed onto tangata whenua, iwi, hapu, Local Government and Central Government. This report documents a generic set of Maori indicators to monitor wetland condition and trend and is based on work carried out with a large number of Maori organisations and individuals. Background information on Maori environmental indicators is given in section 2, concepts to underlie Maori wetland indicators are given in section 3, and resulting Maori environmental monitoring methods are outlined in section 4. Comment is made on state-of-the-environment reporting, and the use of spatial databases is considered.

1. Introduction

1.1 Project overview

Phase 2 of the Coordinated Monitoring of New Zealand Wetlands Project was carried out between July 2000 and June 2002 to provide nationally consistent indicators and tools for coordinated monitoring of wetland condition and trend in New Zealand. The work continued from that carried out in the Phase 1 wetlands project 1998–1999 (UNEP/GRID 1998a, 1999b). The Phase 2 project comprises four goals: (1) science-based indicators for wetland condition and trend; (2) a generic set of matauranga Maori-based indicators for wetland condition and trend; (3) an illustrated field guide and key to the national wetland classification; (4) a handbook for managers. This report documents Goal 2 of the wetlands project to identify, establish, and document a set of generic set of matauranga Maori (iwi and hapu) indicators for wetland condition and trend. Goal 2 was organised into 3 parts: outputs 2a, 2b, and 2c:

- Output 2a: Record and identify a generic set of matauranga Maori (iwi and hapu) based indicators for wetland condition and trend
- Output 2b: Field trial, verify, and calibrate matauranga Maori based indicators for national application
- Output 2c: Determine a set of generic Maori wetland indicators for national application and document final results in one report.

Goal 2 also makes some recommendations on the potential use of information systems for Maori environmental monitoring and how these can be linked for national application.

Methods included working with a number of iwi and hapu representatives, Maori researchers, and kaitiaki communities in wetland areas, partly based on former relationships and contacts established in the Phase 1 project (Harmsworth 1999; UNEP/GRID 1999b). The first part of Goal 2 (Phase 2) was to establish contact again with a number of Maori organisations, iwi, hapu, and individuals (since Phase 1), and develop a memorandum of understanding or partnership with some of these groups, and a working relationship with others. A number of wetland sites were then selected based on these relationships and contacts. The wetland study areas included those from North Island regions: Auckland, Waikato, Bay of Plenty, central North Island, and Manawatu/Horowhenua; and South Island regions: Canterbury/Otago/ and Southland. This included the addition of a number of culturally significant wetlands. Once contact had been made, steps involved developing an understanding of Maori concepts and approaches for each area, identifying and building on previous indicator work, understanding Maori values and aspirations, developing appropriate frameworks and classifications for indicator development, and determining methods for environmental assessment and reporting. Conceptual approaches and Maori knowledge was recorded during field visits, hui, one-on-one interviews and discussion with Maori resource managers, researchers, planners, and kaumatua, and interaction with other wetland specialists. A range of wetland environmental performance indicators were identified and recorded through hui/workshops and field visits.

The second part of the project (output 2b) was to field trial, verify, and calibrate the Maori wetland indicators recorded in output 2a, and to evaluate their effectiveness for national application. A set of environmental wetland indicators for national application were identified and evaluated for use in national assessment and reporting.

All methods and results are documented (output 2c) in this final report. Methods for collecting Maori knowledge took into account sensitivity issues surrounding this type of information. The

confidential nature of the information and associated intellectual property rights affected the way the information was finally documented and used. This report briefly discusses the recording and storing of Maori knowledge on information systems and databases using culturally appropriate methods. Comment is made in the last section of this report on ways to represent and report Maori environmental indicators, and to link Maori knowledge to information systems, such as geographic information systems (GIS), and to national and regional spatial wetland databases. A future requirement will be to improve access to national and regional wetland databases by iwi, hapu, Maori organisations and Maori researchers.

1.2 Progress reports

Goal 2 of Phase 2 started in December 2000 and built on some of the work previously carried out in Phase 1. An initial Phase 2 workshop was held at University of Waikato, Hamilton on 1November 2000, where Phase 1 results were reviewed and new Phase 2 and Goal 2 work was outlined and prepared for the workshop proceedings (Downs et al. 2000). Goal 2 progress reports were made during the year and filed as Phase 2 quarterly and status reports to MfE: 1st quarterly report February 2001; Status report 1 July 2000–30 June 2001; 2nd quarterly report October–December 2001; 3rd quarterly report January–March 2002. Steering group meetings were held 23 August 2001, WRC, Wellington; 22 November 2001, Palmerston North; 21 March 2002, WRC, Wellington; and 24 June 2002, Wellington.

A national workshop to report on Phase 2 results from 2000–2002 was held 2–3 May 2002 at Brentwood Hotel in Wellington (Harmsworth 2002) and a workshop proceedings was prepared (Clarkson & Ward 2002). This final report, LC 0102/099, documents a set of Maori indicators for wetland condition and trend.

1.3 Maori and wetlands

Wetlands are one of New Zealands' most important freshwater ecosystems. They are low lying waterlogged areas bordering rivers and streams, and forming quiet edges of lakes, rivers, lowlying floodplains, estuaries, and harbours. They are classified into a large number of types, including swamps, bogs, fens, marsh, peat-lands, pakihi, flushes, lagoons. In the last 150 years more than 90% of New Zealands' wetlands have been destroyed or significantly modified through draining and other anthropogenic activities.

Under section 6(e) of the Resource Management Act (RMA) 1991 "the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, wahi tapu and other taonga" is a matter of national importance. Wetlands are regarded by Maori as a taonga (of significant value, a treasure),and are especially important as a source of food and traditional materials. Many wetlands have historical and cultural importance and may include wahi tapu. They are mahinga kai (food gathering) sites used by local marae and hapu, and provide significant habitats for a range of culturally important animals, fish (including tuna or eel), birds, reptiles, amphibians, and insects. They are a reservoir and source area for an array of culturally significant plants for weaving, including harakeke, raupo, toetoe and kuta, for carving (whakairo), and for other Maori implements. They may also contain a variety of culturally important medicinal plants for rongoa (Maori medicines). Common Maori words for describing a wetland include "repo" and "ngaere".

Other functions of wetlands are as effective riparian buffers for nutrients, and they are often regarded by Maori as equivalent to organs that cleanse the body (tinana) such as the kidneys (nga taakihi, nga whatukuhu, nga whatumanawa), and the liver (te ate), and therefore represent important sites for purifying and cleaning, by filtering or reducing nutrients, chemicals, and suspended sediment before it reaches the river or stream. They are often the interface between terrestrial ecosystems and freshwater ecosystems. Wetlands may therefore have a valuable role in future, as

part of the whole catchment ecosystem, for enhancing stream and river health and improving the mauri of waterways.

1.4 Previous hui

A number of hui held as part of the Phase 1 project in 1998 and 1999 (Harmsworth 1999) found a high level of interest by Maori organisations in being able to monitor the health of wetland systems within their rohe. Many saw benefits such as:

- collecting and storing information on wetlands and creating spatial databases on wetlands
- legitimising and acknowledging matauranga on wetlands
- restoring wetlands
- being able to monitor the status, changes, and modification of wetlands through time, and developing procedures to assess and measure restoration/rejuvenation of wetlands
- developing monitoring systems for use by kaitiaki or tangata whenua to monitor the health of wetlands
- state-of-the-environment reporting.

Maori groups who worked within the Phase 1 project 1998–1999 identified their wetlands as taonga (significant treasures), comprising culturally important plants, fish and bird species, invertebrates. There was a high level of awareness in the importance of wetlands for the breeding and migration of various fish and bird species. The importance of wetlands was viewed holistically in relation to coastal and freshwater ecosystems. It was agreed that a definition of what constitutes a wetland from a Maori perspective would help in identifying wetland type, location and areal extent of culturally significant wetlands.

1.5 Confidentiality, ownership, and use of intellectual property

It was necessary at the start of goal 2 that some clear explanations and guidelines were established to cover use of Maori knowledge and information. In particular; information acquired during the research was only to be used in accordance with the wishes of the participating Maori groups, especially where this involved confidentiality and sensitivity issues. The procedures for publishing results from this research were fully discussed with participant communities and it was agreed that no results would be disseminated without prior consultation, approval, and the appropriate acknowledgement of those participating in the research.

An agreement signed with iwi or hapu authorities at the beginning of the project stated:

> Ownership of knowledge, data, and results will be subject to a separate agreement between the sub-contractor (Manaaki Whenua) and the Iwi and hapu groups the sub-contractor works with. Ownership of all existing **proprietary data and information** (including all Maori sourced information, matauranga Maori and local Maori knowledge), used for the Work remains the property of the originating Party, and such **existing data and information** may only be used for the Work for which it is supplied. Further use or disclosure of such **existing data and information** by either party will require the express permission or written approval of the owning Party (e.g. tangata whenua). Information such as information required for contract reports and information systems (e.g. GIS) will only be recorded and documented following approval of the originating party (e.g. tangata whenua, kaitiaki community, Runanga) the sub-contractor agrees to work with.

The agreement went on to state that there was a distinction between original information/data and new or modified data/information:

> ***New data and information*** (i.e. data changed substantially in form from the original data or new methods) obtained during the Work shall be owned by the Client. Methodological approaches and new types of data developed by either party shall be the property of the

developing party. Publication of scientific papers, reports, popular articles, and any form of media release based wholly or in part on such ***new data and information*** will require written approval of the Client. Furthermore each Party agrees not to represent the other Party in any forum without the express permission of the other Party.

1.6 Maori environmental monitoring

Each Maori or kaitiaki community, often within a rohe, will have a set of "environments" with which they have a relationship, with which they are familiar, and about which they have knowledge. These environments will range from general to very specific and localised (e.g., coastal-marine, sand country, fluvial, land, lakes, hill country, native forest, wetlands, estuaries, harbours, geothermal, air, urban). In terms of Maori participation in environmental monitoring, Maori need to be convinced of their role in monitoring and of the benefits that may accrue from this. It is important to establish integrated environmental monitoring programmes that have parallel Maori input, are adequately resourced, and where Maori can develop their own approaches. Some type of parallel Maori state-of-the-environment report could be an important way for Maori to report on the environment from their world view or perspective. Questions that need to be to asked are:

- how do Maori see their environment changing through time, in what direction, what are their perception, their aspirations, their goals?
- what indicators do Maori use to identify changes in the state of their environment, and is the environment getting better or worse?
- how do Maori measure and perceive changes in environmental health?
- what indicators, from a Maori perspective, can be used to assess, measure, and determine positive or negative change?
- how can Maori knowledge and a cultural perspective be used in conjunction with, and complement, western or mainstream science perspectives and approaches?
- how can Maori wellbeing be taken into account in state-of-the-environment reporting?

Once these questions are answered, planning for the future can begin, negative change can be identified, and positive actions that embrace Maori values and take into account Maori knowledge can be formulated. One of the most important points of environmental monitoring is that it must take place within the context of environmental or cultural goals by which performance is measured.

2. Background to Maori Environmental Monitoring Concepts

2.1 Introduction

An indicator is something measured or observed regularly to show trends or sudden changes in the state of an environmental system, population, or individual (MfE 1997,1998a). A trend often relates to the way people value an environment, and cultural values can be very important in setting environmental standards and guidelines that point towards or away from some type of natural or culturally acceptable state.

2.2 Maori participation in the MfE EPI programme

As part of the Environmental Performance Indicators (EPI) programme, a panel of independent Maori was set up by MfE in 1998, to complete the following tasks:

- define the concept of a Maori environmental performance indicator (MEPI)
- develop a framework(s) within which MEPIs currently and might operate (and Maori environmental monitoring generally)
- develop a set of generic Maori environmental performance indicators.

This work signalled a start to Maori involvement in the national EPI programme. The information from these early hui was documented in "Maori Environmental Monitoring" (MfE 1998b), which provided a useful basis for developing conceptual approaches for identifying MEPIs. The Maori advisory panel, through a series of hui, and discussions with other individuals, defined first the concept of a MEPI, two frameworks within which Maori could monitor the environment, and provided some examples of generic MEPIs along with concerns and issues that should be considered during identification of MEPIs. The panel located itself in the "Tikanga Maori House" during hui and discussions, as opposed to the "Tikanga Pakeha or Crown House" represented by Government or Crown departments. The model used by the panel advocates discrete independent houses, within which Treaty partners conduct affairs, discuss issues, etc., which are then brought together or integrated as a partnership in the bi-cultural "Treaty House".

2.3 MfE approach for developing Maori EPIs

The Ministry for the Environment developed a "three-tier approach" to the Maori input into the EPI programme (MfE 1998b, 1999):

- an umbrella discussion group (independent Maori advisory panel, MfE 1998b)
- strand by strand contracts (Gardiner & Parata 1998a,b)
- Maori ecosystem case studies (MfE 1999).

As part of the ecosystem case studies and other SMF funded work a number of reports have been completed since 1998 detailing Maori environmental approaches and indicators. These have included the Taieri River case study by Gail Tipa (Tipa 1999), the Hauraki Customary Indicators Report (Hauraki Trust Board 1999), and the Goal 4 report for the Phase1, Coordinated Monitoring of New Zealand wetlands (Harmsworth 1999). Other Maori case-study work is presently being carried in the Gisborne-East Coast and Taranaki regions (MfE *pers. comm.*). More detailed or specific types of Maori environmental monitoring for specific environments, have also being designed and are being trialled, evaluated, and refined by several other groups around the country (Tipa 2002).

2.4 Conceptual frameworks for Maori environmental monitoring

Frameworks can be used to provide context for the identification and application of Maori EPIs. Two main Maori frameworks were proposed by the Maori advisory panel in 1998 (MfE 1998b):
a) The Mana Whenua framework:

- orientates a Maori community towards planning for their environment independently of external considerations and concerns.

b) The Integrating framework:

- recognises that Maori monitor the environment along with other kinds of groups such as Crown agencies
- would require Maori communities first to plan independently within their environment, before integration.

These two frameworks were based on the definition of "Primary Maori groupings" and "secondary Maori groupings", as summarised below:

- Primary Maori groupings – relationship with environment is drawn from whakapapa, e.g., tangata whenua, mana whenua
- Secondary Maori groupings – relationship with environment from some other philosophy.

Primary and secondary groupings both operate to different degrees in the mana whenua and integrating frameworks, and are not specific to any one framework.

2.5 Environmental Performance Indicators

An indicator is something measured or observed regularly to show trends or sudden changes in the state of an environmental system, population, or individual (MfE 1997, 1998a). Based on some benchmark or acceptable standard, it should be able to show whether the environment is getting better or worse (Morgan-Williams & Mulcock 1996). Many of these standards for MEPIs should tie in closely with community values and aspirations, and be acceptable to a community as well as be related to scientific standards (e.g., water quality).

The Ministry for the Environment defines an environmental performance indicator as a measure (e.g., distance from goal, target, threshold, benchmark) against which some aspects of policy performance can be assessed. They are often referred to as the "signposts for sustainability" (MfE 1997, 1998a). EPIs should be used against a reference point, to gauge the significance of the change, either statistically or through some form of quantitative or qualitative analysis.

2.6 Definition of a Maori Environmental Performance Indicator

From a number of discussions held in the "Tikanga House" (MfE 1998b) the Maori panel was able to provide a concept of a Maori EPI. As seen in the report (MfE 1998b), this concept evolved from a series of "ideas", and provides a good conceptual platform of what is expected from a MEPI, and how to define criteria for a MEPI. The final conceptual definition given by the Maori advisory panel was:

> A Maori Environmental Performance Indicator (MEPI) is a tohu created and configured by Maori to gauge, measure or indicate change in an environmental locality. A Maori EPI leads a Maori community towards and sustains a vision and a set of environmental goals defined by that community (MfE 1998b, 1999).

2.7 Types of Maori EPIs

A number of ideas have been proposed regarding the types of Maori EPIs that could be developed

or identified (Tuanuku Consultants 1998; MfE 1998b, 1999; Tipa 1999; Harmsworth 1999). In 1998 the MfE Maori panel first proposed two broad types, or groups, of environmental performance indicators, the first "ecocentric" or environment centred, and the second "anthropocentric" or people centred. These are summarised below with examples:

a) Ecocentric EPIs (environment-centred):

- for example, mahinga kai-based EPIs (i.e. information and knowledge from Maori customary use of flora and fauna for traditional purposes)
- for example, local observation based EPIs (i.e. information from local Maori observations of the environment).

b) Anthropocentric (people-centred):

- for example, human ecology based cultural indicators (i.e. knowledge from traditional Maori phenomena that define environmental relationships), including kaitiakitanga, mauri, whakapapa, whanaungatanga, tapu, and wahi tapu.

2.8 Examples of MEPIs

Examples of broad indicator types that might be developed to fit the above criteria are summarised below. Generic species indicators may include something about what is there, something about quantity, and something about quality, for example (MfE 1998b):

- presence of customary species
- quantity of customary species
- quality or condition of customary species.

These concepts were expanded in Harmsworth (1999) to identify wetland indicators that would provide:

- presence and spatial extent, such as presence and spatial extent of culturally significant species (e.g., based on Maori classification systems, what's present?, what was there?, what's changed?)
- quantity of culturally significant species (e.g., areal extent, density, population, access); and
- quality or condition of culturally significant species (e.g., mauri, what's degraded?, assessment of health, Maori classifications).

2.9 Identifying and developing Maori indicators

Discussions with many individuals during the Phase 1 wetland project between 1998 and 1999 (Harmsworth 1999) recognised that a large number of factors needed to be taken into account when identifying or developing MEPIs. The factors included:

- adherence to tikanga
- adherence to processes/protocols/procedures
- previous knowledge of wetlands
- appropriate MEPI frameworks to work within
- resources (e.g., funding, skilled people, key individuals)
- access to relevant knowledge and information held by tangata whenua/runanga representatives (e.g., based on matauranga Maori, environmental knowledge from a Maori perspective)
- access to scientific information and knowledge/national and regional databases/expertise
- communication, coordination, collaboration, and trust (e.g., community or hapu based)
- access to natural resource areas
- Maori classification systems and organisational frameworks for collecting and recording information
- appropriate and consistent methodology
- in-depth understanding as to why monitoring is being carried out

- ability to interpret, analyse, synthesise and integrate information
- acknowledgement of intellectual property rights
- a system, process, or protocol to collect, record, and store sensitive or confidential information
- understanding of MEPIs and their relevance to providing information on environmental change and trends
- ability to synthesise or aggregate selected MEPI information for regional and national state of the environment (SOE) reporting.

These factors were used for developing criteria to help decide what constitutes an effective Maori environmental performance indicator. The above information from the phase 1 project was taken into account when identifying appropriate MEPIs in Phase 2.

2.10 Criteria for selecting an effective Maori indicator

It is important to list the criteria, that forms the basis for determining "a good Maori environmental performance indicator" before selecting key indicators. A number of important criteria, from previous MfE literature (MfE 1998b, 1999; Tuanuku Consultants 1998) and from Harmsworth (1999), were used as a basis and reference for discussion in the Phase 2 project. When selecting MEPIs to trial, indicators need to be identified as:

- tikanga based (follows iwi or hapu rules and values)
- based on information that is still available/obtainable (e.g., matauranga Maori, knowledge still exists)
- meaningful to tangata whenua/iwi/hapu/runanga
- able to be assessed/measured and interpreted both by local and by other Maori groups
- cost-effective
- repeatable
- able to show environmental change in two directions: positive (e.g., enhanced), the same (maintained), or negative (e.g., degraded);
- useful in a wide range of wetland sites, environments, not in a few, and able to be used generically;
- able to show gradational, incremental, or orderly change, ranging from qualitative to quantitative;
- practical and tangible – this must be explored more fully with groups.

2.11 Maori environmental performance indicators for wetland condition and trend

Two main groups of wetland indicators were proposed in Harmsworth (1999). These would provide information on:

- the spatial extent (i.e. area) of wetlands and areas of different types of wetlands. The grouping or categorisation of different types of wetlands would be based on wetland classifications. A Maori definition on what constitutes a wetland or different types of wetland was regarded as helpful in this respect.
- the condition or health of wetlands.

To identify change at intervals over months and years, both indicator types would be temporal. It was recommended that a suitable national reporting time frame, to identify and report detectable environmental change, be repeated somewhere between 1 and 5 years. More regular or continual environmental monitoring by local community groups should be strongly advocated, to provide information on any ongoing, or sudden deletrious change to a specific wetland environment. Examples of Maori environmental performance indicators for wetlands were given (Harmsworth 1999) and the indicator list was intended to stimulate discussion at the onset of a Phase two

wetlands project. It was believed at the time that the environmental performance indicators could equally be modified for application to other strands identified by Ministry for the Environment (MfE 1997, 1998a,b; 1999; Gardiner & Parata 1998a,b). The environmental indicator list from the Phase 1, Goal 4 wetlands project (Harmsworth 1999) included:

- number and areal extent (hectares) of existing culturally significant wetlands (e.g., taonga)
- number of culturally significant wetlands drained (hectares change since 1860?)
- number of culturally significant wetlands at risk (hectares)
- health of harakeke; yield of quality leaves for weaving purposes (MfE 1998b)
- spatial extent of wetlands containing culturally significant plants (based on a Maori values classification, which takes into account traditional use, etc.)
- number/per unit area, of culturally significant plants (e.g. taonga) in selected wetlands (sites defined for national monitoring, including culturally significant sites)
- number/per unit area, of culturally significant fish species present in selected wetlands
- number/per unit area, of culturally significant manu (avian spp.) present in selected wetlands
- number/per unit area, of culturally significant macro-invertebrates present in selected wetlands
- access/change in access, by marae/hapu to culturally significant plants, vertebrate and invertebrate spp., e.g., what was there?, when?, what's disappeared since what date?
- water quality assessment of selected wetlands by tangata whenua;
- Maori water/water quality classifications;
- mauri (i.e. the internal life element, life force) classification for selected wetlands. Mauri implies life and spirit.

3. Methods for developing Maori wetland indicators

3.1 Introduction

Goal 2 of the Phase 2 project began in October 2000. A generic set of Maori wetland indicators for wetland condition and trend (Goal 2) were developed through hui, interaction and comment from a large number of iwi and hapu groups and individuals, and review of iwi and kaitiaki reports (e.g., Tau et al. 1990; Mitchell & Davis-Te Maire 1993; Tipa 1999, 2002; Hauraki Maori Trust Board 1999; Kawakawa Charitable Trust 2001; Lucas Associates 2001; numerous unpublished reports, papers, and file notes). The present work has involved representatives from Ngai Tahu, Ngati Naho (Tainui, north Waikato), Ngati Te Ata (Waiuku-Manukau), Hauraki, Ngati Tuwharetoa, Te Arawa, and Ngati Raukawa (Manawatu-Horowhenua), and Ngati Porou. Within each tribal rohe, a number of wetlands were used for collecting information on Maori knowledge, to help with indicator development, and for trialing and evaluating indicator methodology. Most wetlands were selected on the basis of their cultural significance. They were selected from many regions including Auckland, Waikato, Bay of Plenty, central North Island–Taupo, Gisborne–East Cape, southern North Island–Horowhenua–Manawatu, and the South Island, including, Canterbury, Otago, and Southland. A large number of wetland field sites were visited and other discussions took place in iwi and hapu offices. Methodology, as in the Goal 2, Phase 2 contract, was initially separated into three main outputs, 2a, 2b, and 2c, outlined in the introduction of this report. The outputs were mainly carried out between January 2001 and June 2002. A number of iwi and hapu sub-contracts were developed between January 2001 and June 2001 for Goal 2 work to proceed.

Methods involved some key progressive stages:

- review previous work carried out on Maori environmental indicators (section 2 of this report) understanding Maori concepts and frameworks for indicator development, and building on previous work for Maori environmental monitoring and indicator development
- determine Maori conceptual frameworks for use in this project
- document relevant wetland information and generic Maori knowledge on wetlands
- document Maori terms for wetlands and integrate with scientific classifications
- visit field sites and office discussion with iwi and hapu representatives
- record a range of wetland indicator types which could be used by Maori for national application
- identify generic Maori indicators through a selection process and criteria matrix
- organise indicators into pressure, state, and response indicators
- develop a draft Maori wetland monitoring assessment sheet
- select field sites to trial generic Maori indicators and methodology, evaluate, refine, and calibrate
- determine a set of generic Maori wetland indicators for national application and incorporate methods and results into a final report.

Information was collected through review of previous documents, summarising iwi and hapu documents (e.g., wetland restoration plans, Maori environmental monitoring documents), collating Maori knowledge and terms for wetlands (Appendices 1&2), and identifying taonga for key wetlands with iwi and hapu representatives, kaitiaki groups, through hui/workshops, discussion groups, field visits, and individual interviews. A large amount of material was also sent to the key researcher in the project for summary and incorporation into Maori methodology and to help selection of key indicators. Interim results and progress reports were documented throughout the project (section 4.1 – Results).

From June 2001 to June 2002 a number of wetland sites were selected for field visits and discussion (Table 2). Some of these sites were selected during the earlier Phase 1 project, and other culturally significant wetland sites were selected during this Goal 2, Phase 2 project. Many of these sites were visited by the key researcher and by iwi and hapu researchers. Once key Maori wetland indicators were identified, environmental monitoring field assessment sheets were prepared. These assessment sheets were sent to many iwi and hapu researchers for trial, evaluation and comment. Comments from iwi and hapu researchers were then used to modify the sheets into a final version incorporated in Appendix 5 of this report.

3.2 Maori concepts

It was important to establish a conceptual and culturally appropriate process and framework, and establish a whakapapa for indicator development. A number of important Maori concepts form the basis for developing MEPIs and environmental monitoring:

Whakapapa
Ranginui is the sky father and Papatuanuku is the earth mother. They have several children or departmental Atua. Whakapapa expresses connections to the natural and spiritual world. The wetland indicators are derived mainly from the Atua domains of Tangaroa, Tutewehiwehi, and Tane Mahuta.

Te reo
Maori wetland terms were used in conjunction with the Phase 1 wetland classification system (UNEP/GRID 1998b, 1999a,b) to identify some Maori equivalents of similar wetland environments, to assist the visualisation of broad wetland types, help understanding of hierarchical subdivisions and descriptions, and to develop some equivalent te reo for the main components of wetland types. The scientific hierarchical classification has six main levels: a) Level 1, Hydrosystem; b) Level 1A, Subsystem; c) Level II, Wetland class; d) Level IIA, wetland form; e) Level III, Structural class; f) Level IV, wetland composition or dominant cover. Hydrosystems, the highest order, are shown with Maori equivalents in Table 2. Some Maori equivalents are also given for other hierarchical levels in Appendix 2.

It was necessary to link Maori wetland terminology to the Phase 1 hierarchical scientific wetland classification system when developing Maori methodology for Goal 2. This formed a framework to help locate thinking (whakaaro) within certain wetland environments, provide an organisational basis/structure for the development of indicators, help visualisation of scientific concepts, and help communicate wetland types and environments to associated Maori values and Maori knowledge.

The integrated framework helped gain a common understanding of wetlands and improved definitions of wetland ecosystems. It is useful to link scientific information and knowledge on wetlands with Maori concepts and definitions, which together build a more complete understanding of wetland ecological systems, landscapes, environmental processes, and relationships between people, cultural values, and wetlands.

Mauri
Mauri is a very important concept for Maori indicator development, which in its component parts means (Black *pers.comm.*1994):
Mau: continuing, lasting, established, fixed
Ri: screen, bond, protecting, bind
U: fixed, reach land, arrive at.

Mauri is often defined as the essential essence of all being, a life principle, the internal element, the sustaining life force of everything, the source of life and sometimes referred to as mauri ora. The

basis of mauri is whakapapa, and therefore transcends or permeates everything (e.g., flora, fauna, people, land, sea, atmosphere, tangible objects). It is the internal element within a person (Black *pers.comm.*1994). The term was used by traditional Maori to express everything as comprising proportions of a spiritual and physical state; resources could not only be physically but also spiritually damaged. More contemporary use has broadened the definition in a variety of situations. Te mauri was expressed by John Panirau (at the national wetlands workshop in May 2002) as the glue or soul that binds the wairua (the spiritual dimension) to the natural ecosystem body, using the Pauatahanui wetland as an example, if this bond is weakened or severed, the mauri is weakened, damaged, or lost completely. Another definition given by Ngati Te Ata was "In essence, the expression of tapu, wehi, ihi, mana, and kaha make up the mauri. All components act as one, inseparable, they themselves represent our identity. If one of these things is transgressed, how does this affect the rest? If the mana of one component is defiled what happens to our mana, our identity? We strongly believe we must protect that identity." "Mauri can be depleted and renewed through the actions or insults of people." One Ngati Porou description was: "Food symbolises the presence of mauri in a particular place. The number of cultivations and variety and abundance of kai is an indicator of the lands ability to sustain life. Thus the mauri is intact." Mauri in the Taieri catchment report on Maori environmental monitoring Tipa (1999) was defined as: "the life force that ensures that within a physical entity, such as the sea, all species that it accommodates will have continual life", and other information included: "the mauri is defenceless against components that are not part of the natural environment"; "mauri seems to be whatever it is in an ecosystem which is conducive to the health of that ecosystem". Hauraki Maori Trust Board researchers defined mauri as "the life force that impacts on all aspects of Maori existence"; "the concept of mauri is fundamental to the exercise of kaitiakitanga"; "mauri is the vital energy force that gives being and form to all things in the universe providing the interconnection between humankind and the natural environment"; sustaining the mauri ensures that a balance is maintained between people and the natural and spiritual worlds (Hauraki Maori Trust Board 1999).

Most people believed mauri was never completely lost or extinguished, as this would imply the system was totally dead, with no evident life forms. Mauri was rather like a glimmer of hope, a flicker of light, an essence, and implies a system can be restored and improved from a degraded state, but seldom back to a pristine state. It was often thought the wellbeing of people would also improve if mauri was restored or enhanced to some degree. This would be a sign that intactness or balance was being brought back into the system, and that mauri was reflecting a strengthening relationship between people and a specific part of the environment. More contemporary definitions of mauri have defined it as vitality, or even an indicator of regenerative capacity (Durie 1994). It has also been described as an intrinsic value of the total ecosystem (Harmsworth 1995). When used in the context of the community or whanaungatanga, mauri is of paramount importance to the wellbeing of people.

Apart from the life-supporting capacity of an ecosystem, mauri embraces the connection between tangata whenua and the environment. It signifies the spiritual significance of a place or site and emphasises the human relationship to that part of the environment. This makes it an important indicator for Maori as it assesses the environmental health of an area at a physical and spiritual level, makes a statement on the relationship between tangata whenua and parts of the environment, places a resource or wetland in a historical context, and assesses the condition of that resource or taonga from a Maori perspective based on association and knowledge. This type of information in state of environment reporting will be significant in showing how Maori see their environment changing through time.

Tikanga

The set of principles and practices to achieve the goal of mauri maintenance often recognise four planes of reality:

taha tinana – a material state, the body

taha hinengaro – a mental state
taha wairua – a spiritual state
taha whanaugatanga – a related or associative state.
There are many variations of these concepts. These main planes of reality or states together help Maori understand the natural environment in a very holistic sense. They also provide a balanced perspective of the world. The first state, tinana, is what we are exposed to through our senses, our smell, touch, vision, hearing. The second state, hinengaro, is the mental state of improving knowledge and understanding, and thinking holistically about the natural environment, based on the premise that everything is interconnected and that thinking has to be able to understand the complete picture. The third state, wairua, is spiritual. It is strongly tied with peoples values, relationships, beliefs, attitudes, feelings about a place or the natural environment as a whole. The final state, whanaugatanga, emphasises association with the natural environment, and the relationships between people. This state is critical for understanding the relationship between people and the natural environment, learning from a long period of co-existence with the natural environment, and understanding the effect human activities have on the environment.

Kaitiakitanga
Kaitiakitanga is often described as guardianship, but is much more than just that. For many Maori it represents responsibilities and obligations, and reinforces the spiritual attachment to the natural environment. The root word, kaitiaki, includes aspects of guardianship, custodianship, care and wise management. The prefix kai denotes the agent by which the tiaki is performed. Kaitiakitanga as a system takes place in the natural world within the domains of Atua. To most Maori, kaitiaki is not a passive custodianship (Te Wananga O Raukawa 1998). Neither is it simply the exercise of traditional property rights, but rather entails an active exercise of power in a manner beneficial to the resource. Kaitiaki who practice kaitiakitanga do so because they hold authority, that is, they have the mana to be kaitiaki. Kaitiaki are the interface between the secular and spiritual worlds, as the mana for kaitiaki is derived from mana whenua. Hence kaitiakitanga is inextricably linked to tino rangatiratanga (authority, inherent sovereignty, autonomy).

Maori frameworks and classifications
Maori have often developed frameworks and classifications to understand, communicate knowledge about, regulate, restrict and manage parts of their natural and spiritual environment. These have been represented through an understanding of cultural values. The following terms are examples that reflect the way traditional Maori saw the world. In respect to water, Maori fully understood that water was a fundamental requirement for survival, and were conscious of the links between water and health (Durie 1994). Several degrees of water purity were recognised by Maori and separate sources of water were used for different purposes. An understanding of these terms is highly relevant in the development of indicators for wetlands. The general classification of water was adapted from Douglas (1984):
Wahi tapu – traditionally referred to sites or places of ritual constraint or prohibition (Hemi Kingi). In the HPA 1993, wahi tapu was defined as “a place sacred to Maori in the traditional, spiritual, religious, or mythological sense” and generally used to acknowledge sacred sites.
Wahi taonga – Often includes sites of importance, including pa sites, tracks (ara), kainga, marae, rock carvings, mahinga kai, cave areas, archaeological sites, tohu, traditional occupation sites, rock formations, significant stands of forest or trees, etc.
Urupa – burial sites.
Mahinga kai – areas and locations where food or any sort is gathered, grown or hunted, including forests, swamps, lakes, rivers, cultivatable soils, etc.
Waiora – is the purest form of water, such as rain-water, it is the spiritual and physical expression of Ranginui’s (sky father) long desire to be re-united with Papatuanuku (earth mother). Pure water is termed “te waiora a tane” and to Maori it contains the source of life and wellbeing. Contact with Papatuanuku gives it the purity as water for human consumption and for ritual. Traditional water could only remain pure without being mixed and was protected by ritual prayer. Traditionally

waiora had the potential to give life, sustain wellbeing, and counteract evil.
Waitohi – areas of pure water.
Waitapu – sacred water used in rituals. Rituals used running water, sometimes termed wai matua o Taupapa (virgin water as it flows from the earth). Water was applied using certain plants, not human-made vessels.
Waipuna – generally pure spring water that comes from the ground (e.g., hillside or underground springs).
Waimaori – water becomes waimaori when it comes into unprotected contact with human beings (e.g., running streams, lakes). It therefore becomes normal, usual, or ordinary and no longer has any particularly sacred associations. Waimaori is often used to describe water that is running, unrestrained, or to describe water that is clear or lucid. Waimaori has a mauri (which is generally benevolent) and was controlled by ritual.
Waitai – used to describe any water that is tidal, influenced or related to the sea (the domain of tangaroa) and includes waves, surf, estuaries, tidal channels, river mouths (e.g., salt water). It is used to distinguish sea water from fresh water (waimaori, waiora). Waitai was water that was returned to tangaroa. Maori often thought in cycles and processes of generation, degradation, and rejuvenation. It had uses for seafood (kaimoana), bathing and healing.
Waimataitai – significant estuarine or brackish waters.
Waiwera – hot water used for healing purposes, bathing, recreation.
Wai whakaheketuupapaku — water burial sites.
Waikino – literally means bad or impure water (e.g., stagnant pools). Often associated with past events, polluted or contaminated water.
Waimate – water that has lost its mauri, or life force. Mate is associated with death, and waimate may have been used in places of contamination and tapu, historic battles, dead, damaged or polluted water, where water has lost the power to rejuvenate itself or other living things. Waimate like Waikino has the potential to cause ill fortune, contamination or distress to the mauri of other living things or spiritual things including people, their kaimoana or their agriculture. The subtle difference between waikino and waimate seem to be based on a continued existence of mauri (albeit damaged) in the former, its total loss in the latter. Waimate also has geographical meaning: to denote sluggish water, a backwater to a mainstream or tidal area, but in this sense the waimate retains its mauri.

Traditionally, each body of water was considered to have its own source of life, its own mauri (Durie 1994). If the mauri of one body of water came into contact with another, both were placed at risk and the ecosystem equilibrium was disturbed (Durie 1994). The mixing of water or the separation or division of natural systems can markedly affect and decrease the mauri in many places. Rivers or streams flowing into one another, into a lake, into a harbour or estuary, are often assessed with different mauri. That mauri is often assigned either to specific parts of a river, stream, or lake, or applied to the whole ecosystem. Therefore Maori environmental concepts focus on keeping specific parts of the natural environment pure, unpolluted, and connected. Most Maori involved in this Phase 2 project believed mauri could not be totally extinguished and that all systems had “a glimmer of hope” when it came to sustaining life. They recognise some places can be restored or rehabilitated while others cannot. They also recognise that mauri can be enhanced to some extent through the actions of kaitiakitanga and by the actions of other agencies. Maori environmental concepts are holistic and look at the whole landscape or catchment. This holistic approach is used to identify where a problem originates and determine what is, or is not practical in terms of enhancing mauri. If the mauri is defiled or weakened, it is necessary to identify the source of the problem, define the stress or pressure placed on the system, and then work to remedy or remove that problem to some degree, in line with a certain amount of pragmatism.

For Maori, discussion during this project and evidence from Treaty claims, shows an overwhelming preference for impure water (e.g., mixed water, polluted water, land effluent, treated sewage, industrial waste) to be treated through land first, rather than direct entry into natural water ecosystems. This affirms Papatuanuku as the appropriate filter for impure water (e.g., such as

through terrestrial and artificial wetlands), and emphasises the importance of maintaining the integrity of the mauri of each water mass (Durie 1994). It also indicates the future need to discuss and prescribe wetland function and use carefully from a cultural perspective, and within this context determine values and the appropriate management of culturally significant wetlands.

3.3 Wetland scientific classification systems

A standardised hierarchical scientific classification system for wetlands was developed in the Phase 1 project (UNEP/GRID 1998b, 1999a,b) and provided the basis for identifying and defining specific environmental performance indicators for a range of wetland types. In Phase 1 the wetland classification system was applied, evaluated, and refined at a number of wetland sites in five New Zealand regions: Auckland, Waikato, Canterbury, West Coast, and Southland, before being adopted for national use. It was an essential step before to any wetland indicator development. This classification was referred to continually during development of Maori indicators.

3.4 Frameworks for developing Maori indicators

An organisational framework, based on Maori concepts and Maori wetland terminology (above), was extremely useful in guiding the development of Maori wetland environmental indicators (Table 1). It aided the communication for different wetland environments using descriptive information, and allowed the type of wetland being discussed to be visualised using a picture or image. As the project progressed, the framework was used to compare Maori indicators across wetland types, and then to aggregate these indicators for national use. Once information was organised in frameworks it helped develop indicators initially for:

- particular wetland environments, giving some specificity for Maori knowledge and values from these environments
- achievement towards specific environmental goals, and the recording of cultural values for specific wetland types
- cross communication and understanding of wetland types providing a basis for synthesis and future aggregation of information on wetlands
- building a knowledge base on distinct wetland types from both a cultural perspective and mainstream science perspective
- developing a set of generic Maori wetland indicators
- establishing a basis on which Maori indicators can complement scientifically based indicators
- the future development of Maori and mainstream science information systems and databases.

Table 1 Maori terms for the main "level 1" wetland types

Phase 1 Wetland classification – Level 1 Hydrosystem	**Maori equivalent terminology**
Estuarine (estuaries, lagoons, etc.)	Wahapu /Hapua
Palustrine (emergent plants over freshwater, swamps, bogs, marsh)	Repo
Marine (saline, coastal, subtidal)	O Te Moana,a Tangaroa
Lacustrine (lakes, ponds)	Roto, Moana
Riverine (rivers, streams, creeks)	Awa, Manga
Geothermal (warm to hot subsurface and surface water)	Waiariki, Wai puia, Ngawha Waiwera, Waipuna (Springs)
Plutonic (underground water, from springs, possibly limestone or karst terrains)	Rarowhenua, Waipuna (Springs)

3.5 Wetland study sites

A number of wetland sites were used to identify indicators, record Maori knowledge, and test concepts for the development of Maori wetland indicators (Table 2). While some of these wetland areas were used previously in the Phase 1 wetlands project, helped build iwi relationships (Harmsworth 1999; UNEP/GRID 1999b), the majority were culturally significant sites within tribal rohe, selected during Goal 2. A large number of the wetland study sites in Table 2 were used to trial, evaluate and comment on provisional Maori indicators and Maori environmental indicator assessment forms that were sent out to many iwi and hapu researchers between October 2001 and April 2002. A large amount of information was discussed with iwi and hapu representatives, and comments and other information on Maori indicators was sent back to the key researcher for refinement of assessment sheets, and collation and incorporation of Maori knowledge into this report. A number of documents, both published and unpublished, sourced from iwi and hapu researchers were also used during this project, and are referenced. Many of the wetland trial sites and tangata whenua who helped with the development of Maori wetland indicators are acknowledged in Table 2.

Table 2 Wetland trial sites and iwi or hapu involved

Wetland	System Type	Iwi/hapu/Maori org.
Oruarangi	Palustrine (induced) now Estuarine	Tainui, Makaurau marae Auckland University
Puhinui	Estuarine	Ngati Te Ata
Ta Tangarau	Palustrine	Ngati Te Ata
Kaituna	Palustrine	Te Arawa
Kaituna	Riverine	Te Arawa
Whangamarino	Palustrine	Ngati Naho
Waikare	Lacustrine	Ngati Naho
Waikato awa	Riverine	Ngati Naho
Waihou	Riverine	Hauraki
Hauraki	Palustrine	Hauraki
Kopuatai	Palustrine	Hauraki
Wairakei	Geothermal	Ngati Rauhoto, Ngati Te Urunga, Ngati Tuuwharetoa
Waipahihi	Geothermal	Ngati Rauhoto, Ngati Te Urunga, Ngati Tuuwharetoa
Ohau river	Riverine	Ngati Raukawa, Ngati Tukorehe
Kuku Stream sand country	Palustrine	Ngati Raukawa, Ngati Tukorehe
Motueka—Nelson	Palustrine, Riverine, Estuarine	Ngati Rarua, Te Ati Awa, Ngati Tama
Wairewa	Estuarine	Ngai Tahu
Sinclair (Nohoaka o Te Tukiauau), Waipori	Palustrine	Ngai Tahu
Graham's wetland (Taieri)	Palustrine	Ngai Tahu
Pakahiwi o Tahumataa	Palustrine	Ngai Tahu
Te Rapuka	Palustrine	Ngai Tahu
Waimataitai	Palustrine	Ngai Tahu
Wainono (part)	Palustrine	Ngai Tahu
Orere, All Day Bay (Kakanui coast)		Ngai Tahu
Opiro (Sir Charles Creek)	Palustrine	Ngai Tahu
Jericho?	Palustrine	Ngai Tahu

3.6 Maori wetland indicator methodology

From a Maori perspective, most environmental systems are under considerable stress, and environmental pressures (e.g., land-use, land management, weeds and pests, pollution) and environmental change (e.g., land-use, land-use activity) have had, or are having, a great affect on Maori values. Most wetlands throughout New Zealand are highly modified and degraded. During the initial stages of Goal 2, through hui and discussion groups, Maori expressed interest in four main groups of wetland indicators:

1) presence and absence of culturally significant plant, animal, fish, bird and other species (*taonga*) which indicate to Maori whether the wetland condition is healthy or not, and reflect the degree to which iwi and hapu values are being expressed or represented. These were essentially indicators Maori wanted to see more of in a wetland and were grouped at this stage as *taonga.*

2) presence/abundance of pests or “unwanted flora and fauna”, usually foreign, exotic or introduced plants, animals, bird and fish species, some examples included willows, gorse, algal growth, catfish, koi carp, glyceria, wattles (acacia). Most iwi and hapu representatives would prefer less of these indicators in and around wetlands as they associate them with reducing the spatial extent, number and condition of the taonga indicators. These indicators were generally equated to a perception of environmental stress, degradation, negative effects on mauri, and other problems.

3) a measure or assessment of "mauri" (life force, internal element, essential essence of all being), which was regarded as very important. Maori need to express their relationship and values with a place or area within both the spiritual and physical dimension, through concepts such as mauri, mana whenua and kaitiakitanga. As mauri is a statement about the interconnectedness and balance of the wetland system, a mauri assessment provides a holistic approach to assess not only the wetland itself but also its relationship with tangata whenua, and other people, and how they interact and use the wetland. It also assesses the catchment area around the wetland, taking into account various impacts from human activity, both historically and present. The condition and health of a wetland needs to reflect Maori values and knowledge, whakapapa, and the spiritual relationships tangata whenua have with a particular area.

4) an assessment of cultural heritage indicators, which further establishes and identifies connection and relationship to a wetland. This may include wahi tapu, and wahi taonga sites such as paa, marae, kainga, etc. Many iwi and hapu individuals were interested in the level of protection and management of particular wetland areas or sites, and the present degree of modification to cultural sites.

Through a review of iwi and hapu documents, collation of Maori knowledge, hui, discussion groups, field visits to wetlands, and discussion with many individuals, a long list of possible wetland indicators was documented from June 2000 to December 2001, and examples are shown below. As they were collected the indicators were organised into the four main groups above, but renamed in terms of their ability to show trend towards or away from cultural values. Much of the information in the early stages of Goal 2 was from both scientific sources and Maori knowledge. The indicators were regarded as providing important information to Maori about the changing health status of various wetland environments. Maori wanted to have greater access to much of this information for use in future monitoring, management and policy development of wetlands. Indicators were organised as below, and much of this information was written on whiteboards or sheets of paper before being typed and sent out for comment. Most discussion with iwi and hapu was interactive, many questions, concepts and types of information were discussed. The main indicator groups (adapted from the four groups above), with examples from original notes, are shown below.

Group 1: Indicators that give a positive measure of wetland condition and align with Maori cultural values (taonga of wetlands)

(i) Indicator: Rakau, nga otaota, ngahere (Plants)
Examples: harakeke, kuta, raupo, ti kouka, kahikatea, maire-tawaki, toetoe, carex, kanuka/ manuka, ferns, plants available for weaving (raranga), medicinal plants for rongoa, water cress
What to measure/assess: Numbers, proportion, quantity, areal extent of native plant spp.; harakeke variety and yield; areas of healthy harakeke; native plant areas versus introduced plants (areal extent, proportions, ratios); native plants: leaf size or leaf area, quality of leaf, weight, appearance, height and size of plant; length and area, and health of riparian native areas.

(ii) Indicator: Nga ika, nga kararehe (Fish/animals)
Examples: tuna (eels), koura, koaro, kokopu, kaakahi (fresh water mussel), native tarauta, *estuarine, marine examples:* toheroa, tuangi, kanae, aua (mullet), kahawai, pipi, tuatua, flounder, fresh water oysters, karoro (cockle)

What to measure/assess: Size and condition (colour, texture, taste) of mussels, pipi, toheroa, karoro; no., proportion, quantity, areal extent of fish spp.; natural habitat maps; no., size and abundance of tuna (eel), no. of yellow bellied tuna; no. of tuna species; colour of tuna; area of suitable tuna habitat; size, colour, texture of fish spp.; no. of fish caught in a (short) net (mesh size) within a specified time-frame; mind maps of fish spp., tuna; present fishing grounds versus historic fishing areas; habitat attributes?.

(iii) Indicator: Nga manu (birds)
Examples: tui, pukeko, kereru, weka, shags, parera, putangitangi
What to measure/assess: Observation of birds; bird calls; no. proportion of taonga versus introduced spp.; amount of native birdlife present; sound (intensity) of native birds (within some time-frame).

Group 2: Indicators that give a negative measure of wetland condition and impact on Maori values:
(i) Indicator: Plants
Examples: willow, grey willow, crack willow, gorse, blackberry, *pinus radiata*, himalayan honeysuckle, glyceria spp., algal growth, *lagarosiphon* spp. *egeria* spp., *elodea* spp.; hornwort, c*ompsopogon hookeri* (red algae), water buttercup, pondweed, water net
What to measure/assess: Invasion, numbers, type, areal extent, proportion of exotic-introduced plants to native plants; area of natural habitats affected, mahinga kai areas affected by exotic plants.

(ii) Indicator: Fish, animals
Examples: koi carp, catfish, trout, mosquitofish, rudd
What to measure/assess: Numbers, type, quantity, density, affect on native habitats, cost of control?, frequency observation of exotic fish within a time-frame; catch, numbers of exotic fish caught with a time-frame or with certain size net.

(iii) Indicator: Animals
Examples: Possums, goats, rats, stoats, ferrets, fallow deer, cattle, horses;
What to measure/assess? No., type, quantity, density, affect on native habitats, cost of pest control? frequency/observation of exotic animals within a time-frame; catch, no. of animals caught with a time-frame.

(iv) Indicator: Mea kitakita, Mea moroiti, nga merowhetau mea ora (Micro-organisms)
Examples: cryptosporidium, giardia, other protozoa, bacteria, viruses
What to measure/assess: Numbers and quantity present; illnesses associated with micro-organisms.

Group 3: Indicators that provide an assessment of te mauri (wetland health)
(i) Indicator: Te mauri (i.e. the internal life element, life force); mauri (life force of wetland system, life element, life support, wairua, mana, tapu, ihi, wehi, kaitiakitanga, waiora, waimaori, waipuna, waikino, waimate; degree of naturalness, degree of contamination, degree of modification). An area either has mauri or has lost its mauri. Are there degrees of mauri? Can an area move towards a state of mauri or away from mauri? Are changes irreversible or reversible? Can the mauri be restored? What actions are needed to restore mauri?

What to measure/assess: presence/absence of taonga spp.; spiritual association with wetland; name of wetland in te reo; mahinga kai; Maori wellbeing; access to wetland; riparian vegetation; observed pollution; industrial sites and landfills around wetland; level of contamination; nutrients; assess number of drains carrying pollutants; identify contaminants; effluent; heavy metals; other water mixing; introduced plants and animals; livestock access; streams; land use around catchment; roading networks, culverts and drains; no. of drains and watercourses discharging into wetland system; areal extent/proportion of inappropriate land uses, land-use practices adjacent to a wetland; no. of streams; catchment land-use; discharge of effluent, sewage, and heavy metals; major

contaminants, heavy metals, what's causing degradation, or loss of the "mauri" of the wetland system? Could also be the way the wetland is modified, e.g., dams, reduced water table, etc. Water clarity is also obviously a measure in some areas; record water level; water table; colour of water; water level related to required natural habitats; no. of effluent discharges from dairying; point discharges; industrial waste discharges; storm water discharge, industrial sites/mining proximity; pathogen counts; bacterial counts (*campylobacter*, *E.coli*, coliforms); effluent conc.; leachates present; number of native spp. present; native versus exotic species present; closeness to natural water levels; quality of native plants, water cress; area of mahinga kai; how far wetland system has moved away from Maori values; number of reported incidents of human sickness, Maori health problems associated with eating kai from wetland; odour from wetland system; amount of sediment entering wetland system; water temperature; no. and frequency of livestock entering wetland.

Techniques: Use Maori knowledge to make an assessment of mauri; observe and record mauri based on matauranga; develop taonga-natural habitat maps; record spatial extent/area, of mahinga kai sites; map catchment land use around a wetland system; map area and type of land uses around wetland; record pollution; identify fertiliser use, application adjacent to wetland system; use of chemical sprays in and around a wetland system; discharge of treated, raw human sewage; number of drains discharging storm water; number of drains discharging industrial waste contaminants; number of industrial sites/mining sites within a certain distance/radius/ proximity to wetland system; degree of modification away from wetland naturalness; measure water level; measure groundwater; observe or measure sediment; amount/levels of chemical sprays/pesticides/poisons used in and adjacent to wetlands (also relates to biosecurity, etc.).

(ii) Indicator: Water quality
Examples: water clarity, taste, feel, ingredients
What to measure/assess: water quality assessment of selected wetlands by tangata whenua; Maori water/water quality classifications; observations, water clarity; observed or measured sediment; observed or measured pollution; water colour; water taste; feel of water; frequency of floods.

(iii) Indicator: Mahinga kai
Examples: record Taonga; No. of people using wetland for mahinga kai; number of people with access to natural mahinga kai areas; amount of food collected per year from mahinga kai or within some timeframe
What to measure/assess: Area of healthy mahinga kai, amount of kai collected within some time-frame; observation and collection of quality native plants, fish, tuna.

(iv) Indicator: Maori wellbeing/health condition indicators
Examples: Health illnesses, psychological illnesses
What to measure/assess: Number of people from marae who collect food from wetland; number of people with reported sickness; number of people, as proportion (from marae), with concerns of mahinga kai health; number or area of culturally significant plants and fish habitats at risk from pollution, sediment, contaminants, etc.

Group 4: Cultural heritage indicators (many wetlands or areas adjacent to are also cultural heritage sites)

(i) Indicator: Cultural sites, cultural heritage sites, wahi taonga, wahi tapu
Examples: wahi tapu; wahi taonga within or adjacent to wetlands, te reo Maori terms, names (place names).
What to measure/assess: Areal extent, modification/destruction, no. of sites affected by human activity, drainage, urban subdivision; no. of sites recorded in district plan; no. of sites protected; degree and use in which Maori terms and place names are used; use of te reo Maori for wetlands and taonga; use and length of fencing used to protect wetlands, cultural sites, native plants.

In summary, Maori identified a large number of indicators regarded as important for future monitoring:

- culturally significant plants, fish, birds grouped as “taonga indicators” (based on a Maori knowledge, Maori values classifications) which had an emphasis on mana, traditional use and wellbeing
- culturally unsatisfactory indicators, unwanted species and other factors (e.g. exotic plants, exotic fish, pollution, sediment, algae)
- water table, water level to support natural habitats and taonga
- natural habitat maps, historical baselines, present versus the past
- an assessment of te mauri
- assessment of mahinga kai (wetland) health
- discharges and quality of watercourses entering a wetland system
- cultural heritage.

3.7 Complementary monitoring approaches

Once a large number of indicators of interest to Maori had been recorded (examples in previous section 3.6), the indicators were organised into the three main categories below:

- Maori indicators, based on Maori knowledge and matauranga which requires in-depth cultural understanding, to be monitored and interpreted by Maori with this expertise and skill
- Non-Maori derived indicators but providing useful information to Maori. These indicators were termed community–scientific, requiring limited to moderate scientific/technical measurement, or using semi-specialised techniques, where indicators could be measured by community groups, Maori organisations, such as kaitiaki communities, regional councils, and scientists. Monitoring, with these indicators, uses limited and inexpensive field equipment, but requires a basic level of training and some experience in collecting information in wetlands
- Scientific indicators requiring specialist scientific knowledge, techniques, and often specialist equipment. These indicators, some mentioned in section 3.6, included indicators such as contaminants, heavy metals, nutrients, pH, bacteria, micro-organisms, requiring specialist science skills to collect samples, analyse, and interpret information. The information was regarded as highly useful information to Maori, but only Maori with these skills could collect and interpret the information.

The 3 categories are shown in Table 8, and identify the main source of the indicators and their knowledge source, the level of expertise required, examples of the indicators, and who should be responsible (individual, group or agency) for collecting the indicator information as part of a large regional or national monitoring programme.

3.8 Criteria used to determine key Maori indicators

Once the indicators were defined into groups, and those based only on Maori knowledge determined (section 3.7), the Maori indicators were checked using a matrix (Table 3). This narrowed the Maori indicators down to those that could be used at a national level (generically), across a range of wetlands, based on tikanga and cost effectiveness, and those that could involve Maori communities in their own environmental monitoring once adequate training had been given. The indicators selected needed to be able to provide information on wetland condition and trend, to be used for state of the environment (SOE) reporting, and to provide an indication of how Maori see their environment changing through time, and whether cultural values are being enhanced or lost.

The matrix in Table 3 shows the criteria used on the y-axis, and a large number of potential indicators were written and checked off across the x-axis. This criteria checking resulted in a small

number of suitable generic Maori indicators that could be used for national application.

Table 3 Criteria matrix method for selecting Maori knowledge-based wetland indicators

Criteria	Wetland indicators (e.g., June 2001 – sections 3.6, 3.7)									
Based on Maori knowledge										
Tikanga based										
Based on Maori methodology										
Meaningful to tangata whenua										
Maori knowledge still available										
Cost effective										
Can be assessed and interpreted by Maori communities										
Repeatable										
Able to be used in a wide range of wetland environments – generic										
Show environmental change										
Can show incremental change and trends										
Defensible										
Complements scientifically based indicators										
Informs about wetland condition										
Can be used for SOE reporting										

3.9 Taonga lists and inventories

Some of the key indicators for Maori involved listing taonga, such as significant flora and fauna fauna (Strickland 1990; TRONT 1998; HMTB 1999). Many Maori organisations have already started these lists within their tribal rohe or for specific places, through Treaty claims, iwi and hapu management plans, resource inventories, environmental reports. At a national level for wetlands, it was impractical to list all taonga species as separate indicators as there is so much variation from one wetland system to the next, so one of the final generic Maori indicators in Goal 2 became simply taonga. This could be applied to any tribal area, or site, at any scale.

Maori often use the presence or absence of taonga to identify or indicate the state of health and condition of different environments. If a certain type, number, or quantity of taonga are present, this reflects cultural values and therefore indicates a condition in line with Maori aspirations. If certain taonga are missing, or have been damaged or modified, this indicates a move away from cultural values.

Results of many meetings with Maori individuals and groups indicated a need to provide a reasonably comprehensive knowledge baseline before Maori communities became involved in environmental monitoring. This was important for Maori to gain a full appreciation of the change in many wetlands through time. This knowledge base would provide some historic information for selected wetland sites on how they might have looked 100–150 years ago, and what culturally significant flora and fauna might have been originally present. This baseline could be recorded using historic records, Treaty claims, surveying maps, minute books and other documents, and developed for selected wetlands by iwi and hapu researchers themselves. The taonga baseline could then be used to identify what has been lost, in terms of significant cultural values, for many highly modified wetland systems. It could also be used to provide guidance in rehabilitation and restoration projects. Based on availability of information, it was suggested that three main periods

be used for listing and characterising taonga: 1840–1880; present day; and future. This information would then be used to underpin future Maori environmental monitoring, by assessing generic Maori indicators from a perspective of Maori aspirations, i.e. the flora and fauna Maori would like to see returned or included in specific wetland systems, and those flora and fauna that have been destroyed, modified, or damaged. Table 4 shows the way taonga lists can be developed. Taonga lists from 1840–1880, present, and future, can be used to compare change of taonga through time, and to assess trends in associated cultural values. These lists are required for Maori indicator assessment (Appendix 5).

Table 4 Taonga lists

Taonga 1840 –- 1880	**Taonga — Present**	**Taonga — Future ?????**
Habitats	Habitats	Habitats? To re-establish taonga
Tuna	Tuna	
Inanga	Inanga	Tuna
Paraki (Smelt)	Paraki (Smelt)	Inanga
Lamprey		Lamprey
Aua (yellow eyed mullet)		Kokupu
Kanae (grey mullet)	Kaio (freshwater mussel)	Koaro
Mohoao (black flounder)		
Kaio (freshwater mussel)		Kaio (freshwater mussel)
Koura, Kewai (freshwater crayfish)	Pipi	Koura, Kewai (freshwater
Patiki (yellow belly flounder)	Tuangi (cockle)	crayfish)
Kaawai		
Pipi		Pipi
Tuangi (cockle)		Tuangi (cockle)
Wiwi		
Harakeke	Wiwi	Wiwi
Ti Kouka	Raupo	Harakeke
Kuta	Manuka	Ti Kouka
Raupo		Kuta
Yellow Manuka		Raupo
Manuka, Kanuka		Yellow Manuka
Kahikatea		Manuka, Kanuka
Totara		Kahikatea
		Totara

3.10 Inventories of unwanted flora and fauna species

Maori also recorded a desire to determine and list unwanted flora and fauna, or weeds and pests (Appendix 3), for specific wetland sites. They were generally recognized as unwanted because they competed with and displaced taonga flora and fauna. They were regarded by many Maori as indicators of environmental stress, foreign invasion and colonisation, and as having negative impacts on mauri. As indicators, they equated to having negative impacts on cultural values. By recording these, Maori further indicated a preference for certain types of flora and fauna in wetland systems (e.g. taonga). Most unwanted species were exotic, foreign, or introduced flora and fauna. Many unwanted plants identified by Maori are given in Appendix 3 and in Table 5 below. Many

Maori groups had already put together lists of unwanted species as part of wetland restoration plans or iwi and hapu management plans. Table 5 provides examples of many unwanted flora and fauna cited by Maori during Goal 2 and the form that these can be listed by iwi and hapu for environmental monitoring and reporting. Other information required on unwanted plants was the areal extent and change in areal extent over time, which has ramifications on displacing taonga from wetland systems. These types of tables are required before filling out the Maori environmental monitoring form in Appendix 5.

Table 5 Examples of unwanted (e.g., introduced, exotic) flora and fauna

Main groups of unwanted (e.g., introduced, exotic) flora and fauna					
Animals	Plants	Fish	Birds	Insects	Micro-organisms
Goats Possums Stoats Rats Fallow deer Cattle Horses	Crack Willow Grey Willow Gorse Clematis (Old mans beard) *Pinus radiata* Blackberry Himalayan Honeysuckle Machurian wild rice *Glyceria spp.* *Lagarasiphon major* *Elodea Canadensis* *Compsopogon hookeri* (red algae) Water buttercup Pondweed Waternet	Koi Carp Rudd Catfish Mosquito fish	Ducks Geese	Mosquito	Toxic algae *Giardia* *Cryptosporidium* Bacteria Viruses *E.Coli* *Campylobacter* Faecal coliforms

3.11 Assessment of Mauri

During Goal 2, mauri (section 3.2 Maori concepts) was identified as a key Maori concept by about 95% of all participants for assessing the state of the environment. Some Maori were reluctant to use mauri, especially where Maori knowledge, particularly matauranga, was limited. Some believed it was a concept used more commonly by academic Maori. The majority of people spoken to, and who commented during the project, believed mauri was an essential Maori concept that could be used in the right situation as a generic indicator. Mauri makes a statement about life itself, about values, and demonstrates a connection to Maori wellbeing. To equate with more western thinking, mauri indicates not only the life supporting capacity of an environmental system, but from a Maori perspective makes a major statement about the relationship particular groups, such as kaitiaki and tangata whenua, have with a particular area. It is also a very special indicator in that it takes into account the spiritual dimension through wairua and the relationship through mana and tikanga. Mauri provides a means for assessing balance and inter-connectedness within an environmental system.

A large number of factors in combination are used to assess te mauri and require specialist Maori knowledge in order to make an assessment. Some of the main factors taken into consideration when assessing mauri are shown in Table 6, however, each tangata whenua or kaitiaki group will have

their own method. Other groups may want to include other factors or reduce the number of factors taken into consideration. A number of consistent factors for assessing mauri were demonstrated in work on Maori environmental monitoring in the Taieri catchment, Otago, by Tipa (1999). This initial work on mauri, as a significant environmental indicator, has been extended for national application in Goal 2.

In environmental monitoring it is important that each kaitiaki, iwi, or hapu group develop a consistent approach for assessing mauri that needs to be fully discussed with everyone involved in Maori environmental monitoring. This may mean that the same factors, Table 6, are agreed upon as being central to assessing mauri for that group, and each year when mauri is assessed, these same key factors are repeated by trained practioners. This will probably require training through hui and wananga. The key is developing a consistent approach and robust method that can be used by Maori for Maori environmental monitoring, and which is recognised as a legitimate and meaningful form of assessment for both tangata whenua and Crown agencies. Mauri is a key Maori indicator in the wetland monitoring form (Appendix 5).

Table 6 Examples of some of the numerous factors taken into consideration when assessing mauri

Factors for assessing mauri include:	Factors for assessing mauri include:
The water table Colour of water Water depth Water temperature Colour and size of plants Area/number of Taonga plants present Taonga fish present Abundance of taonga fish species Abundance of all fish species Taonga birds present Sound of birds, intensity of bird calls Whether you can eat plants, fish, from wetland Evidence of foams, oils, sediment and other pollution Evidence of sewage or effluent entering wetland Diversity of fish species Abundance and diversity of bird species	Presence or absence of stock access to wetland Modification of wetland from some baseline state (e.g. historical knowledge, maatauranga) Surrounding land-uses Evidence of contamination/contaminants/industrial pollution Water characteristics of a lake Algal growth Smell of water Flow of river, evidence of oxygenation Characteristics of riparian vegetation and habitat Evidence of introduced pests and plants Maori wellbeing, human health Relationship to wetland, whakapapa, spiritual dimension Mahinga kai Kai

4. Maori wetland indicators for national application

4.1 Results

A number of generic Maori indicators were developed in Goal 2 for wetland monitoring of condition and trend. The methods for deriving these indicators have been discussed in sections 2 & 3. The final indicators are shown below in section 4.2 and in the Maori environmental monitoring form in Appendix 5. It is necessary before Maori wetland monitoring to identify a specific, and manageable, number of culturally significant areas or sites. Some form of training through hui or wananga is essential, as is training in the field. If the capacity is within the tribe, teaching of matauranga should be seriously considered with kaumatua and selected pakeke, rangatahi and tamariki. This will achieve consistency and understanding of Maori environmental monitoring approaches and acknowledgement of tikanga. In summary, the methods in sections 3.9, 3.10, and 3.11, provide the platform for effective Maori environmental monitoring and application and use of Maori indicators. Initial steps involve:

- Developing taonga lists and inventories (grouped into plants, animals, birds, fish, invertebrates, and micro-organisms) as at 1840–1880 and at present
- Recording 'unwanted' flora and fauna, such as introduced pests and plants in and around wetlands
- Developing a consistent methodology for assessing "mauri" (e.g., for each kaitiaki group)
- Assessing land-uses, discharges, and point sources of pollution surrounding or within a wetland
- Assessing wetland modification
- Assessing whether culturally significant taonga species are present or absent in a particular area.

4.2 Maori wetland indicators

From over 100 Maori and scientific indicators initially recorded (section 3 methods section), 9 key Maori indicators were determined in April 2002, all based to some degree on Maori knowledge and expertise. The following indicators express a Maori perspective of how they see the environment changing though time. Furthermore, the indicators provide an understanding of Maori value systems, the way Maori view and perceive the state of health of the environment, and the way they wish to assess and report on the state of environmental health. The indicators can be used to monitor positive and negative environmental changes as determined by Maori communities' values and aspirations:

1. % area of land uses/riparian factors affecting cultural values
2. Number of point (sites) sources of pollution degrading te mauri
3. Degree of modification (draining, water table, in-flows, out-flows) degrading te mauri
4. Number of (and change of) unwanted (e.g., exotic, introduced, foreign) plants, algae, animals, fish, birds (pest types) affecting cultural values (*)
5. Number of (and change of) taonga species within wetland
6. % area of (and change in area) taonga plants within total wetland
7. % area of (and change in area) unwanted (e.g. exotic, introduced, foreign) plants covering total wetland
8. Assessment of, and change in te mauri (scale)
9. Number of cultural sites protected within or adjacent to wetland.

Maori indicators (above) shown in bold are the most critical for assessing environmental change from a Maori perspective. Change in taonga species can be represented as, +, same, or &, with

second and subsequent assessments; and mauri can be assessed to indicate change as worse, the same, improving or by more detailed Maori descriptions.

4.3 Cultural Sensitivity

When developing Maori indicators, cultural sensitivity and intellectual property rights, were of utmost importance. For example, when discussing taonga lists, many groups and individuals did not wish to list all their taonga and release the information. These lists need to stay with Maori groups, such as tangata whenua and kaitiaki, within some type of Maori information system. But this information will be required to provide a figure on number of taonga, and change in taonga over time. In the final monitoring assessment form therefore, it was agreed because of confidentiality that only the number of taonga will be recorded on the assessment form (although full lists will be held by Maori groups), and the change in the number of taonga will be recorded in subsequent assessments. This will provide very useful information on any trends and shifts either towards or away from cultural values. It is believed that recording key taonga species for the present day will pick up any sensitive variations in trend over time (i.e. loss of key taonga, maintenance, or gain in key taonga).

4.4 Naturalness models

Many Maori thought it would be helpful as historical reference to have information on how particular wetlands looked originally, which would provide information on species, hydrology, size of wetland, and perhaps a stylised diagram or graphic of how that wetland might have looked. This would be helpful in recognising both the cultural values associated with each wetland, from a historical and current day perspective, and what had been lost and what could be returned. Furthermore, it would be helpful to know from taonga lists, what taonga could be brought back into a particular wetland, and the key steps needed for habitat restoration or rehabilitation.

Naturalness models, and terms such as natural character, intactness, biodiversity, biotic integrity have been commonly used by scientific and wetland specialist groups to refer to the original condition of many environmental systems, places and sites before human modification and introduction of weeds and pests. Baseline models and historic wetland information provide a glimpse into the past that would be very helpful to Maori, such as kaitiaki groups, wanting to know how much a wetland had changed or been modified from its original state or condition. What has changed or disappeared since some date? what is the potential for some form of restoration?. It would also be very useful information for assessing mauri, and could be used in conjunction with Maori knowledge systems. It will probably confirm what many Maori already know about the loss of mauri in many of these wetland areas but will help quantify that loss and provide guidance for wetland management and restoration.

Mauri often reflects the degree to which an environmental system, such as a wetland, has moved away from a state of “pureness” or “naturalness”. This is often analogous to a shift away from cultural values, if a high number of taonga have been lost, or if the state of mauri is adversely affected by modification or contamination. Maori need to know how far certain wetlands have moved away from a state of “naturalness” or “natural character” and to what degree they still express certain cultural values. Future Maori knowledge systems could contain information on what parts of the cultural and physical environment, such as wetlands, used to look like, what they look like now, and based on Maori aspirations what they could look like in future. Maori often see this “naturalness” in terms of healthy habitats versus highly modified and contaminated habitats, and it would form an important baseline for assessing wetland condition and te mauri. In many examples, the more modified and/or degraded/contaminated the wetland system, the more it has lost its mauri. Many Maori believe cultural values, including mauri (life force), can return to a system to some degree (never totally) with good management. Naturalness models for wetland hydro-systems

together with some cultural values measurement for wetlands will form a useful gauge, for monitoring condition, trends and state of the environment reporting.

4.5 Using the pressure–state–response model

The OECD (1993, 1997) first used the pressure–state–response (P–S–R) framework to develop indicators to encourage thought about environmental issues within a policy and management context (Dymond 2001). The Ministry for the Environment (MfE 1997, 1998a) has also developed the environmental indicators programme in New Zealand within this same P–S–R model context. This allows indicator development to be focused on whether it is creating environmental stress or pressure (e.g., land use, land use activity), whether it is an independent or state indicator (e.g., erosion), or whether it is a response indicator, usually human induced (e.g., environmental policy, regulations, or projects/actions), which can relieve environmental stress or symptoms in some way and contribute to an agreed environmental outcome. The model needs to identify clear sets of environmental outcomes, goals, or targets, to measure trends towards or away from these outcomes, goals or targets (Dymond 2001). An outcome may be to protect and restore all remaining wetland systems within some defined area. The target goals may be to protect and restore 20% of remaining wetland systems to some stated condition by 2010. The vision should determine a future target. Monitoring a response indicator would measure progress towards or away from these targets or goals. Once key Maori wetland indicators were determined in this project, they were organised into the three main P–S–R categories:

- pressure indicators
- state indicators
- response indicators.

Each category was fully discussed with Maori and given more understandable terms for monitoring use:

- what's causing the problems
- taonga and mauri
- trends, getting better or worse (from a cultural perspective).

The key generic Maori indicators for wetland condition and trend (section 4.2) were grouped according to the pressure–state–response OECD model, and more practical, understandable terms were used to explain this model.

4.6 The P–S–R model for Maori indicators

Table 7 shows the Maori indicators organised according to the P–S–R model. An indicator monitoring form was developed using the P–S–R organisational framework, and then sent (July 2001) to all Maori participants for comment, trial and evaluation. The final Maori wetland monitoring form in Appendix 5 was based on feedback and comments received from January 2002 to April 2002. Many Maori groups reformatted the forms and assessment method (Table 7), and then with their own versions, trialled and evaluated the forms in the field. Once completed the forms and comments were returned. Some groups wrote extensive comments, and a few individuals and groups prepared reports. All information was collated for this report and incorporated into the final assessment form (Appendix 5). The information was presented at the national Phase 2 wetlands workshop, 2–3 May 2002, Wellington, where Maori concepts and approaches were explained (Harmsworth 2002, Clarkson &Ward 2002) and comments from workshop participants were used to further refine the assessment form for national application.

Table 7 Maori indicators: original wetland monitoring form sent out for comment June–November 2001

Name of wetland:
Date:
People involved in monitoring:

Kia kaha te mahi! - Please write actual numbers, percentages or description beside each below before giving a score as below (under heading assessment):

WHAT'S CAUSING THE PROBLEMS?
Pressure indicators
% area of land uses/riparian factors affecting cultural values (#)
No. of point (sites) sources of pollution degrading te mauri (*)
Degree of modification (draining, water table, in-flows, out-flows) degrading te mauri (@
No. of exotic (introduced, foreign) plants, algae, animals, fish, birds (pest types) affecting cultural values (*)

TAONGA AND MAURI? (Maori information about the wetland, its attributes)
State indicators
No. of taonga species within wetland (*)
% area of taonga plant species within total wetland (#)
% area of exotic (introduced, foreign) plants covering total wetland (#)
No. of cultural sites within or adjacent to wetland (*)
Assessment of te mauri (scale)

TRENDS/WETLAND GETTING BETTER OR WORSE? (2nd and subsequent assessments)
Response indicators
Change in No. of taonga species within wetland (i.e. +, same, &), (*)
Change in % area of taonga plant species within total wetland area (i.e. +, same, &), (#)
% area of exotic (introduced, foreign) plants covering total wetland (i.e. +, same, &), (#)
No. of cultural sites protected within or adjacent to wetland (*)
Assessment of change in te mauri (e.g. worse, same, improvement), (scale)

Assessment method (scores)
- (@): 1 = low; 2 = moderate; 3 = high; 4 = v. high; 5 = extreme.
- Mauri scale: 1 = weak or low; 2 = average or moderate; 3 = strong or high.
- (#): 0 = 0%; 1 = 1-20%; 2 = 21-40 %; 3 = 41-60 %; 4 = 61- 80 %; 5 = 81-100 %;
- (*): 0 = 0; 1= (1 - 2); 2 (3 - 5); 3 (6 - 9); 4 (10 -14); 5 (>15).

Other comments:
(e.g. use of wetland, customary access, customary rights, fitness for traditional cultural usage)
The final wetland monitoring form is shown in Appendix 4.

4.7 Summary

It was important throughout the development of methods that a terms of reference, or framework, was followed to guide the development of Maori environmental performance indicators. The key criteria central to this framework are listed below. Maori indicators needed to be:

- based on Maori concepts and frameworks
- based on Maori knowledge
- based on consistent and robust methodology
- culturally appropriate, tikanga based
- culturally sensitive, taking account of intellectual property rights
- generic and could be used in a range of wetland types (e.g., wetland hydrosystems)
- could assess wetland condition and trend
- could be organised according to the P–S–R model
- could be used to report on the state of the environment (SOE)
- practical and cost effective.

Through hui, workshops, individual discussion, field visits, and extensive literature review, a set of Maori indicators for wetland condition and trend have been developed. A large number of people are acknowledged for assisting with this work (acknowledgements section of this report).

5. Discussion

5.1 Why should environmental monitoring be carried out?

In designing a system to monitor wetlands and other environmental systems, the most important requirement is to know the purpose. A number of participants in the goal 2 project asked "why should we monitor?", "why should Maori be involved?". The question may reflect the low level of opportunity, participation, and lack of resources Maori have had to date, to be engaged in environmental projects, resource management planning, and environmental policy. It also reflects, to some degree, the low level of human and social capital in many iwi and hapu to carry out this type of work, especially when they are dealing with so many other issues. There is also a vital need for Maori concepts and approaches to be better understood, recognised and acknowledged as a legitimate part of the environmental and science sector in New Zealand. Many of the environmental goals and outcomes for which Crown agencies have a responsibility, and are trying to achieve, are often closely aligned with Maori aspirations and thinking. The main current deficiency in the system is the few examples of Maori working proactively alongside the Crown and non-Crown agencies as 'equal players', where resources are more equitably shared and the Maori contribution fully recognised. There is also a need to overcome the present level of mistrust between Maori, Crown and pakeha in many areas around the country. The alignment of Crown and Maori environmental goals provides a good opportunity to work together for a common purpose, such as wetland restoration and other environmental projects. Agreed environmental goals and outcomes, usually based on a balanced range of human and cultural values, is what actually provides the framework or context for environmental monitoring. Some of the reasons why tangata whenua, iwi and hapu should be involved in monitoring the environment are given below:

- For iwi to monitor for themselves, the health and condition of the environment from a cultural perspective
- To help review performance of iwi and hapu management plans
- For iwi, hapu to prepare their own state of the environment (SOE) reports
- Provide information about what is happening to culturally significant environmental systems through time
- To build Maori knowledge on environmental systems, such as wetlands
- To enhance te reo through environmental projects
- To provide long-term information on environmental change, which acknowledges the significance and legitimacy of Maori knowledge
- To identify changes to the state or condition of the environment
- To identify remedial action to rehabilitate or restore culturally significant environments
- To measure and review the performance of other agencies regarding the welfare of the environment
- To measure and review the performance of other agencies responsible for achieving defined environmental and cultural outcomes
- To fulfil requirements for national and international reporting on the state of the environment.

The question of who will fund more community-based and tangata whenua environmental monitoring also needs to be addressed to achieve a more complete, inclusive and participatory monitoring programme in New Zealand. In this report we have provided a number of methods and indicators to include in some type of regional, district or iwi-based monitoring programme. Future monitoring programmes in New Zealand need leadership, cooperation, and coordination.

5.2 Future environmental monitoring

In general, a comprehensive multi-agency environmental monitoring programme could help:

- identify the spatial extent and condition of wetlands, to maintain and enhance the values that are present
- utilise information from wetland classifications and environmental indicators to identify and target areas (both rural and urban) and types of wetlands for restoration
- provide historic information as a basis for wetland enhancement
- provide baseline information on biotic integrity, biodiversity, and naturalness – from a scientific and ecological perspective – as a basis for wetland protection, management, and enhancement
- provide information on cultural values, Maori knowledge, and taonga – from a cultural perspective – as a basis for wetland protection, management, and enhancement
- provide cultural information for wetland restoration and enhancement
- understand the representativeness, type, and function of wetlands to identify, target, and increase the area of specific wetland types represented in the North Island, South Island and offshore islands
- prepare and plan for collaborative wetland restoration work
- prepare and plan for collaborative learning and research
- state of environment reporting.

Goal 2 discussed who should collect information on Maori and other environmental indicators. In future, environmental monitoring programmes should be classed into three main complementary types (Table 8).

Table 8 Complementary monitoring approaches

Maori knowledge based	Community–scientific based	Scientific based
Maori indicators– Requires in-depth Maori understanding and knowledge of particular environments. Understanding of Maori values, goals, and aspirations required. Examples: • Taonga lists • Key sensitive taonga indicators • Te Mauri • Knowledge on uses and preparation of taonga • Land uses, point discharges, modification, impacting on cultural values and uses.	Community based indicators– Requires moderate levels of technical input and skill but scientifically robust and part-value based. Cost effective, relatively simple and short duration. Examples: • Change in hydrological integrity (impact of man-made structures; water table depth) • Change in physico-chemical parameters (fire damage; degree of sedimentation/erosion; nutrient levels; Von Post index) • Change in ecosystem intactness (loss in area of original wetland; connectivity barriers) • Change in browsing, predation & harvesting regimes (damage by domestic stock; damage by feral animals; introduced predator impact on wildlife; harvesting levels) • Change in dominance of native plants (introduced plant canopy cover; introduced plant under-storey cover)	Scientific indicators– Requires higher levels of technical input and skill, robust sampling strategies, analysis and interpretation. May be time-consuming. Examples: • Chemistry, water quality nutrients • Hydrology • Water table modeling • Botanical mapping, classification of plants • pH • Bacterial counts • Giardia • Cryptosporidium • GIS applications • Satellite imagery • Studies of fish, macro-invertebrates, macrophytes.

5.3 Information systems

Maori ascertained their desire through Goal 2 to have much greater access to environmental information that could be used for planning and policy. For wetlands, this information could be produced and communicated in a variety of ways, for example: hui/workshops, reports, maps, newsletters, guides, handbooks, and internet web sites. Maori wanted information on wetlands that helped them:

- Provide information to assist wetland restoration;
- Define what constitutes a wetland, and culturally significant wetland, from a Maori perspective
- Develop a classification of culturally significant wetlands taonga (plants, animals, fish, birds, insects etc.) for each Maori kaitiaki community
- Determine Maori values for wetlands;
- Identify appropriate Maori indicators at the Maori community level with acknowledgement of

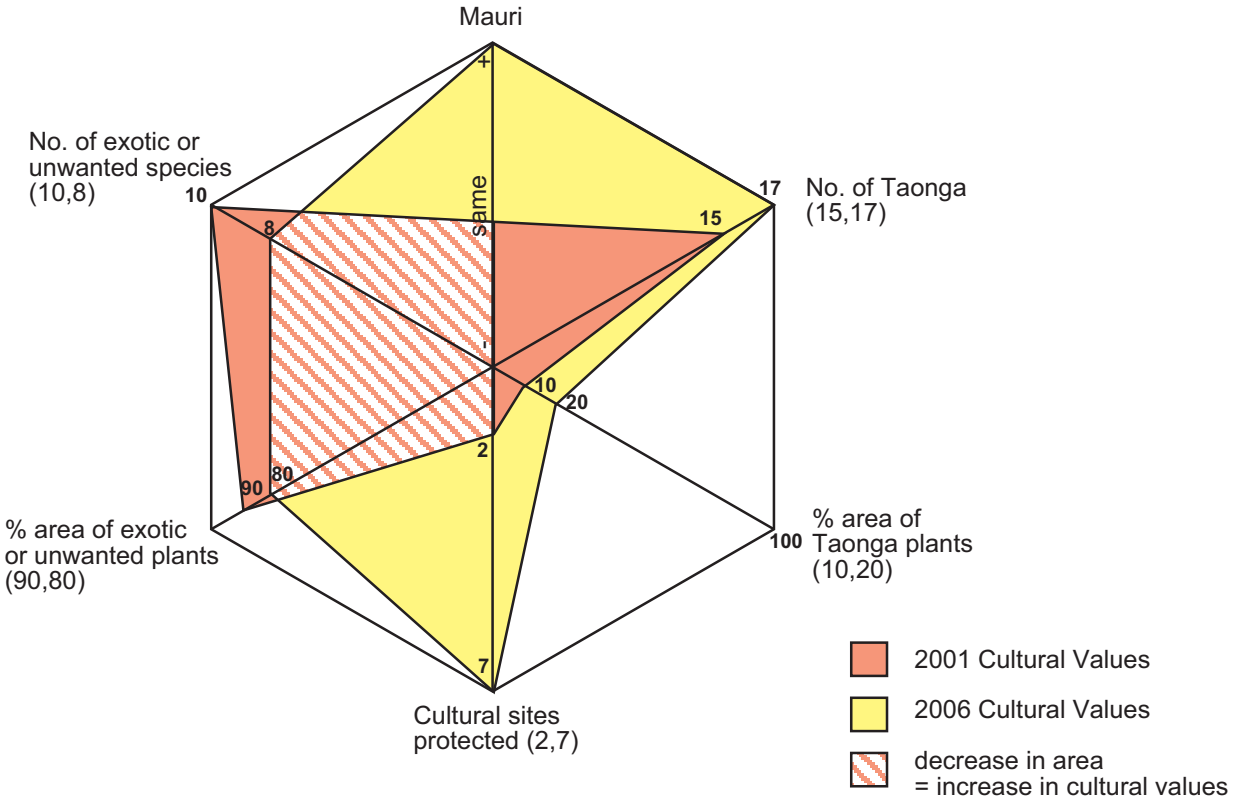
property rights to source;
- Develop collaborative proposals for wetland work with other agencies
- Prepare state-of-the-environment reports that assess environmental and human health, as an extension to iwi and hapu management plans.

Many Maori organisations and groups are presently engaged in developing their own information systems. Many of these systems are being developed to help with areas such as, health, education, training, social services, economic development, property management, and environment. Up-skilling in new technology is a major focus for many Maori organisations, such as iwi and hapu authorities. Spatial databases for recording, analysing, and presenting information in map form is also of interest (Harmsworth 1997a,b). Many have already used spatial information, such as maps, for Treaty claims, iwi and hapu management plans, the development of cultural heritage databases, and for environmental planning. Geographic information systems (GIS) are regarded as being very helpful in the visualisation and presentation of information to accompany discussion, and in the recording, managing, and analysis of information of wetland information to help with, for example: environmental monitoring, managing and restoring wetlands, and reporting on the state of health and condition of wetlands.

5.4 State of the Environment Reporting

Information from Maori wetland indicators can, in future, be recorded and presented in a number of ways. Indicators should express how tangata whenua and Maori organisations see their environment changing over time, for example, monthly, annually, every 5 years. Using indicators of condition and trend, such as mauri and taonga, the information can show whether wetlands are moving towards cultural values or moving away from some pre-determined (e.g., kaitiaki determined) cultural standard, which reflects cultural values. Cultural information could be represented using graphics, computer generated diagrams, pictures, graphs, reports, or expressed orally at hui and workshops. Visual examples using graphics are shown in Figures 1, 2 & 3 using information from the assessment forms in Appendix 5. The methods outlined in this report, the assessment forms, and the way this cultural and environmental information can be aggregated and reported, provide a system and process for Maori to be active in assessing and reporting on environmental change from a cultural perspective. This ties in with the premise to find ways to answer questions such as:
- How do Maori see their environment changing in time?
- How do Maori assess the state of health of the environment?
- What indicators do they use?
- How shall the strong link between environmental change and Maori wellbeing be taken into account in environmental monitoring?
- How can Maori knowledge be used to underpin environmental monitoring?
- How can monitoring by Maori complement other approaches?

Environmental and cultural information could be annually collected and presented to iwi and hapu representatives, to other Maori organisations, to Crown agencies, to researchers and to the general public, using various media. We envisage that reporting on condition and trend could be carried out every 1 to 5 years depending on the rate of change in the environment, as a result of pressure indicators, such as land use, degradation, modification, and pollution. Figures 1, 2 & 3 show that future reporting on Maori indicators could use radar maps or other visual tools for presentation of cultural values.



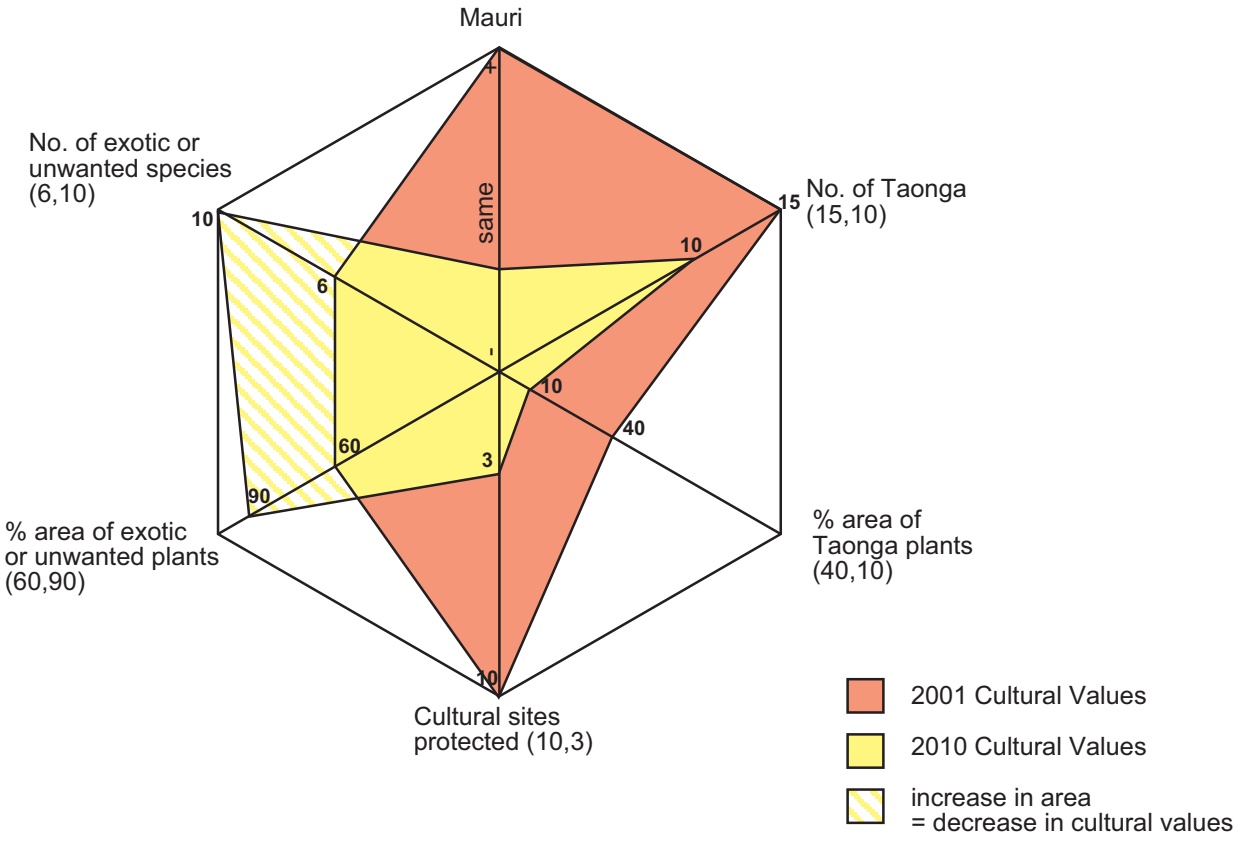


Fig. 1 Maori indicators from Appendix 5 could be represented in radar maps

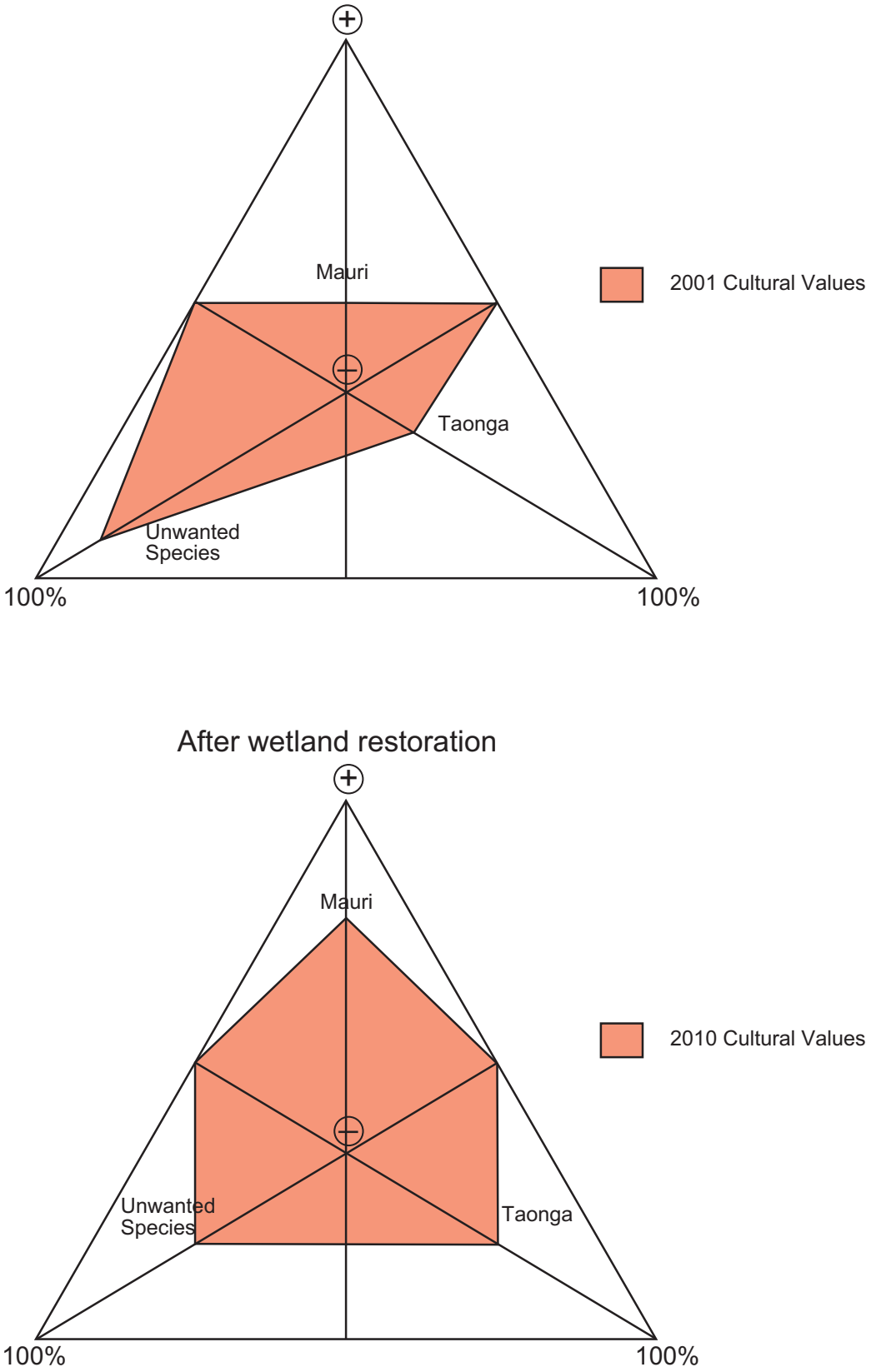
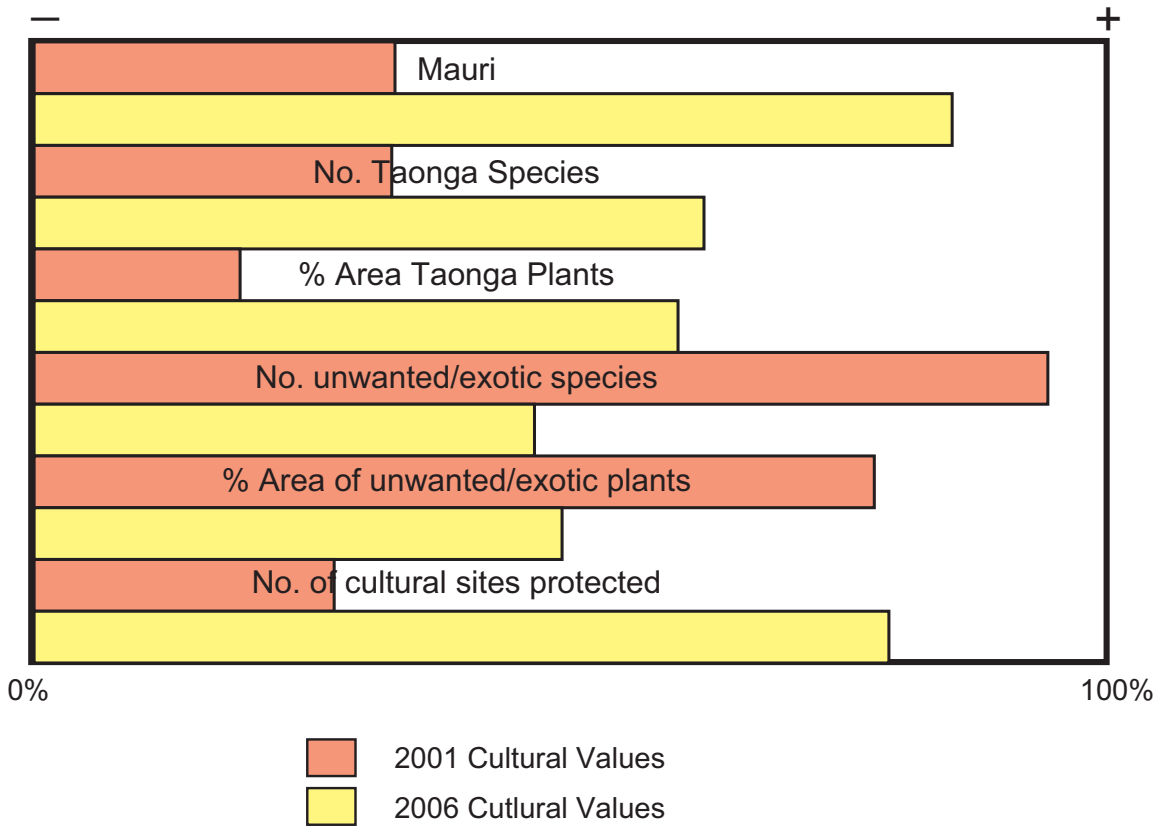


Fig. 2 Maori indicators from Appendix 5 could be shown simply for each axis of a chart or diagram



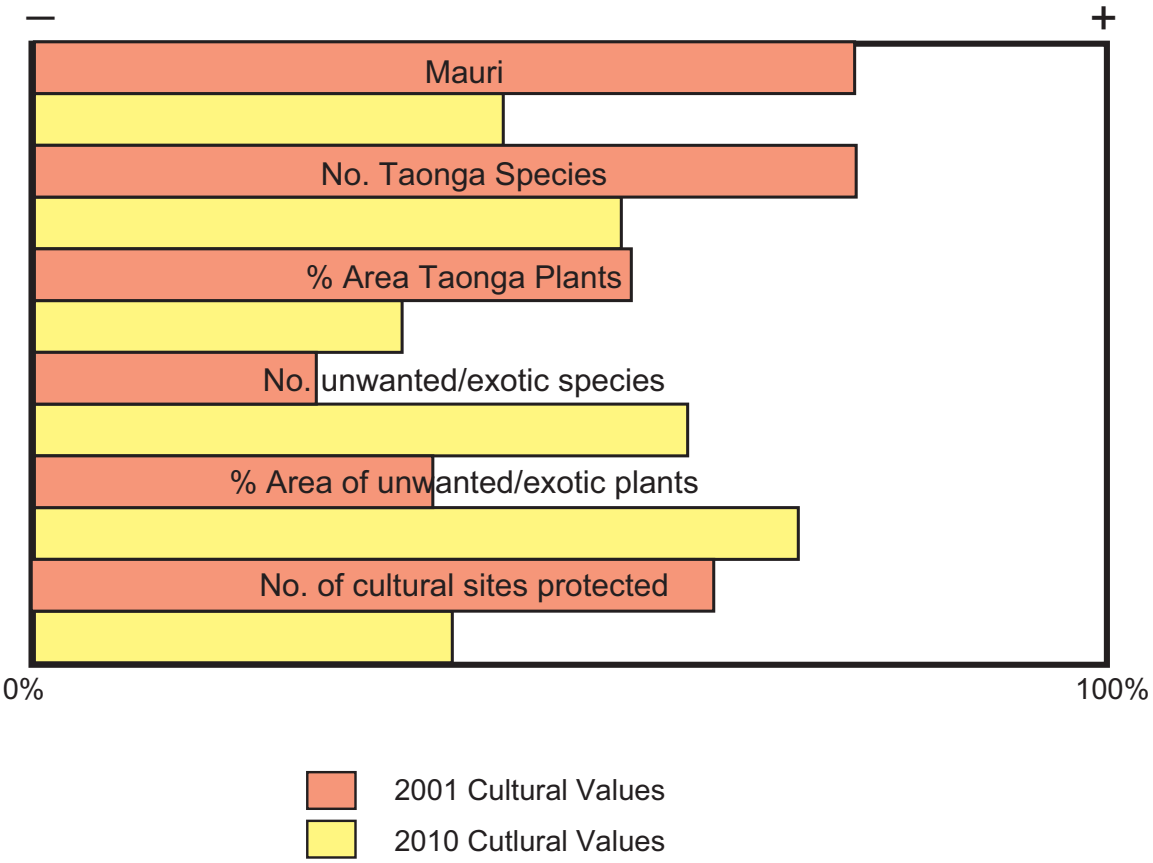


Fig. 3 Maori indicators could be represented through bar charts

5.5 Environmental projects

A process for Maori environmental programmes, indicating the role of environmental indicators and monitoring, could be based on the following progressive steps for any Maori organisation:

- Determine environmental goals and aspirations
- Develop policy and management plans
- Determine Maori values for future action
- Develop a course of action, such as restoration or rehabilitation of an environmental system (e.g., wetland, river, lake edge, sand country, coastal areas, native forest), based on kaitiakitanga principles
- Establish and proceed with environmental and cultural projects
- Use the indicators in this report for environmental monitoring
- Report on progress for achieving aspirations and environmental goals
- Report on the state-of-the-environment for a tribal rohe
- Produce graphics and maps showing environmental and cultural progress towards or away from values

6. Recommendations

An essential requirement for environmental monitoring is for iwi, hapu, local government, and central government to have a clear vision, or sense of purpose for monitoring (OECD 1997; MfE 1998a; Dymond et al. 2001). Maori environmental performance indicators (MEPIs) are developed for use within a context or framework of Maori aspirations and a vision of a specific rohe or wetland area. They reflect tangata whenua or Maori values. MEPIs can measure progress towards defined environmental goals, usually defined by a kaitiaki community.

A set of national and regional policy goals are recommended that reflect Maori values and concepts. The following policy goals are given as an example:

- Maintain and enhance the cultural values of lakes, rivers, and wetland ecosystems
- Identify and work towards cultural aspirations for defined environments
- Assess and report on the degree and proportion to which cultural values are represented
- Safeguard and restore the mauri of the lakes, rivers, and wetlands ecosystems
- Assess and report on the proportion of waters for which mauri has been lost and/or restored.

If these types of policy goals were accepted, the indicators presented in this report could become parameters or attributes of higher-level goals to measure:

- Degree to which cultural values are represented for defined ecosystems
- Change in cultural values for defined ecosystems over time

Reporting by councils should therefore provide information and statements to identify whether, for a defined area such as a significant ecological or cultural environmental system (e.g., wetland), whether that system is moving towards or away from ecological and/or cultural values (Fig. 1, 2 & 3).

Recommendations:

- The Maori concepts and indicators in this report are acknowledged and recognised as legitimate approaches by Crown agencies, including local government and MfE
- Complementary monitoring approaches by iwi and other agencies are supported
- The importance of Maori knowledge as a basis for wetland management is recognised
- Adequate resources be given to Maori environmental monitoring
- The methods and indicators in this report are adopted and promoted amongst iwi, hapu, tangata whenua
- Collaborative programmes, involving iwi, hapu, and Crown agencies, to restore or enhance wetlands are supported
- National and regional policy goals be written to encapsulate Maori aspirations for wetlands.

7. Acknowledgements

A large number of Maori groups and individuals are acknowledged for helping with this work. I wish to thank all those iwi, hapu and whanau who have participated in this project, or contributed time and ideas, and all those that have sent in comments on the proposed indicators and methods, participated in field visits, office discussion, and communication through e-mail, phone, and kanohi ki kanohi. Special mention is made of Te Runanga o Ngai Tahu, Ngati Naho Cooperative Society, Ngati Te Ata and other iwi and hapu participants from Ngai Tahu, Hauraki, Te Arawa, Ngati Tuwharetoa, Ngati Raukawa, Ngati Porou, Ngati Rarua and Te Ati Awa. I especially wish to thank Gail Tipa, Malcolm Wara, Sonny Wara, Rima Herbert, Karl Flavell, Gayle Leaf, and Tui Warmenhoven for their comments, ideas and support. Kelly Davis, John Panirau and David O'Connell are thanked for their contribution and support, especially at the national wetlands workshop 2–3 May Wellington.

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9. Appendices

Appendix 1: Maori terminology for wetlands

Awa: stream, river
Ehu: turbid

Haka: South Island form of Whanga (harbour)
Hakapupu: estuary of shellfish
Huinga: said to mean swamps

Ma: stream
Ma: free from tapu
Manga: stream, creek, tributary
Mangakura: red stream or with red ochre
Mangareporepo: muddy creek
Mangatu: stream of reeds, ngatu is a part of raupo
Mangaweka: stream or creek with weka (woodhen)
Mangawhahariki: stream where flax grows, whahariki is a type of flax
Mataura: swamp water which drains into a river which is full of iron oxide
Maku: wet
Mimi: stream or creek

Ngaere: swamp
Ngatapa: the edges
Noa: free from tapu

Oaro: bog, aro is bog, a boggy place
Opara: muddy place
Orotore: the swamp dwellers, roto means inside, re is short for repo, in Christchurch refers to the historic settlements at the side of the Avon river
Omanawa: place of mangroves
Owahanga: entrance, mouth of river
Otokia: to be wet, o is the place of

Pakihi: flat land dried up and poor
Papa: broad flat land, ground covered in vegetation
Papatoetoe: flat area with toetoe
Parapara: soft mud used for dying flax fibre
Para: type of fern or possibly a swamp, or muds
Paraharaha: black mud used for dying flax fibre
Paretai: bank of river
Paruparu: black mud used for dying flax fibre
Pipiwai: damp or swampy
Poa: sacred food
Pokeno: turbid
Puaha: is the mouth of a river
Puhoi: slow water, tidal
Pukaha: spongy or swampy
Pukepoto: dark blue earth used as pigment, found in nearby swamp
Putarepo: the place at the end of the swamp where it could be crossed

Pukaki: head of creek or where stream meets tidal waters, pu is heaped or bunched up, and kaki means neck

Repo: swamp or marsh
Reporoa: long swamp
Roto: lake
Rotokawau: lake where the shags live, shag lake
Rototuna: eel lake, lake where the eels live
Rotowhio: blue duck lake, lake of the blue ducks

Tahuna:sandbank or shoal
Te Ngae:the swamp

Ua: rain

Wa: season
Wai-iti: little river
Waiharakeke: water where the flax grows
Waikino: bad waters, kino is bad
Waimataitai: brackish water, salty. Descriptive name of lagoon
Waimate: stagnant waters, mate is stagnant, loss of mauri
Waipapakauri: swampy ground where kauri grew
Waipara: stream across plain, river with thick muddy sediment
Waipuke: flood
Wairepo: water running through a swamp
Waitahanui: tahanui (cabbage tree) stream where the cabbage tree grow or backwater area
Waitahora: spreading waters, water spread out or small duck
Waitai: tidal or brackish water, occasionally used where mangroves grow
Waiwhio: water where the whio (blue duck) breeds
Whaka: harbour (South Island dialect)
Whaka raupo: harbour of reeds or raupo
Whanga: harbour
Whangamarino: calm harbour, wetland
Whanga raupo: harbour of reeds or raupo
Whitianga: crossing or ford

Plants
Harakeke: native flax (Phormium tenax)
Kaponga: tree fern
Kanuka: white tea tree (Kunzea ericoides)
Katote: tree fern
Kohukohu: moss Karamu: (Coprosma robusta)
Katote: type of tree fern
Kiokio: native fern

Mahuri: young trees
Mamaku: tree fern
Manawa: mangoves (Avicennia resinifera)
Manuka: red tea tree (Leptospermum scoparium)
Mapere: species of toetoe e.g. Omapere
Mauku: small ground fern (often term used to describe drowned cabbage trees)
Muka: shoot of nikau

Ngawi: native grass

Ponga: tree fern
Puniu: fern

Raupo: native reed, bullrush (Typhas)
Tahanui: a variety of cabbage tree
Takaka: bracken
Te kakaho: toetoe or plume-grass
Ti, Ti kouka: cabbage tree (*Cordyline australis*)
Toetoe: plume grass
Tukura: species of tree fern
Tutu: shrub

Uruti: a grove of cabbage trees, uru is grove, ti is cabbage tree
Watakerehi: watercresses
Whararikí: a type of flax
Wharenui: variety of flax

Introduced plants and trees
Whiro: willow

Nga manu–Bird species
Putangitangi: paradise duck
Tete: blue duck
Parera: wild duck, native duck
Pukeko: water hen
Whio: blue mountain duck
Weka: woodhen
Koko: another name for tui
Kawau: shag
Matuku: bittern

Nga ika–Fish species
Kaoro: small blind fish
Kokopu: small fresh water fish
inanga: whitebait
Ngaiore: common smelt
Paraki: smelt
Rangiriri: smelt
Waikokopu: fresh water fish
Upokororo: fresh water fish
Kopu: small fish
Kopuriki: small fish, riki is few, hardly any fish
Patiki: flounder
Tuna: eel
Hao: small eel
Waihao: eel river
Kauaotuna:young eels
Kirikopuni: dark skinned eels
Kopureherehe: eels that had been fat but became shrunk and wrinkled, kopu is belly and reherehe is wrinkled
Koura: crayfish

Kaeo: freshwater shellfish
Tupa: shellfish
Tuparoa: long shellfish
Poua: shellfish
Pipi: shellfish
Paua: shellfish
Pupu: several kinds of shellfish
Kakahi: freshwater mussel
Hauwai: mollusc

Pokopokoiere: native frog
Piripiripohatu: torrent fish

Appendix 2: Maori wetlands classification framework

Level 1 Hydrosystem	**Maori equivalent**	**Level 1A Sub system**	**Maori equivalent**	**Level II Wetland Class**	**Maori equivalent**	**Level IIA Wetland form**	**Maori equivalent**
Estuarine (Alternating saline and freshwater)	Wahapu Hapua	Intertidal Subtidal Non tidal Inter-dunal		Saltarsh Seagrass meadows Algal Flat Mudflat Cobbleflat Rocky reef Sandflat		Estuary Lagoon Dune slack	
Palustrine (Vegetation emergent over freshwater, not incl. floating plants)	Repo	Permanent Ephemeral	Pumautanga Tuturutanga Rangitahi	Marsh Swamp Fern Bog Flush Seep		Shore Artificial Slope Channel Flat Basin Pool	
Marine (saline open water)	O te moana, a Tangaroa Kaimoana Waitai	Supratidal Intertidal Subtidal		*Examples:* Splashzone Sandy megaripple Boulder reef Coral reef		*Examples:* Exposed coast Embayment Tidal bore Bombie	

Appendix 2 (continued): Maori wetlands classification framework

Level 1 Hydrosystem	**Maori equivalent**	**Level 1A Sub system**	**Maori equivalent**	**Level II Wetland Class**	**Maori equivalent**	**Level IIA Wetland form**	**Maori equivalent**
Lacustrine (standing open freshwater incl. lake, pond, pool)	Roto, Moana	Permanent Seasonal Ephemeral	Pumautanga Tuturutanga waa Rangitahi	Oligotrophic Mesotrophic Dystrophic Eutrophic	Waiora Waimate	 Marginal Littoral Sublittoral Profundal Pelagic	
Riverine (flowing open freshwater, incl. stream, canal)	Awa, Manga	Perennial Tidal	rau tipu tonu Ngau te tai	Steepland Midland Lowland Headwater Floodplain Mouth	 Waipuke papa Parawhenua Papa Roma papa	*Examples:* entrenched channel meander channel braided channel anastomising channel unincised shelf	

Appendix 2 (continued): Maori wetlands classification framework

Level 1 Hydrosystem	**Maori equivalent**	**Level 1A Sub system**	**Maori equivalent**	**Level II Wetland Class**	**Maori equivalent**	**Level IIA Wetland form**	**Maori equivalent**
Geothermal (>30 degrees C or influenced by waters with geothermal chemistry)	Waiariki, Waipuia Ngawha Wairakei Waiwera Waipuna	Permanent Perma flow Seep Splash zone Steam zone Reservoir	Pumautanga Tuturutanga	Marsh Swamp Fen Pool Lake Spring Stream Flush	Repo, roto Repo Hoopua Koopua Papawai Pukenga Roto Te Puna Manga, Awa	Channel Terrace Slope Geoterrace Fumerole Basin Confined aquifer	
Plutonic (underground water, no photosynthesis)	Rarowhenua Waipuna	Permanent Intermittent	Pumautanga Tuturutanga Rangitahi	Aquifer Pool Stream Watertable	Hoopua Koopua Papawai Pukenga Awa, Manga Waitepu	Unconfined Karst cavern Tephra tube Lava tunnel Wet-land	

Appendix 3: Weeds and Pests Table

Scientific Name	**Common Name**
Wetland weeds in New Zealand	
Scientific Name	**Common Name**
Ferns & fern allies	
Azolla pinnata	*Ferny azolla*
Equisetum arvense	*Field horestail*
Osmunda regalis	*Royal fern*
Salvinia molesta	*Kariba weed*
Selaginella kraussiana	*African clubmoss*
Flowering plants – dicots	
Alnus glutinosa	*Alder*
Alternanthera philoxeroides	*Alligator weed*
Alternanthera sessilis	*Nahui*
Apium nodiflorum	*Water celery*
Bidens frondosa	*Beggars ticks*
Ceratophyllum demersum	*Hornwort*
Crataegus monogyna	*Hawthorn*
Erechtites hieraciifolia	*American fireweed*
Hypericum humifusum	*Trailing St John's wort*
Hypericum mutilum	
Ligustrum lucidum	*Tree privet*
Ligustrum sinense	*Chinese Privet*
Lonicera japonica	*Japanese honeysuckle*
Ludwigia palustris	*Water purslane*
Ludwigia peploides	*Primrose willow*
Lycopus europaeus	*Gipsywort*
Mentha xpiperita	*Peppermint*
Mimulus moschatus	*Musk*
Myriophyllum aquaticum	*Parrot's feather*
Nymphaea alba	*Water lily*
Nymphaea mexicana	*Water lily*
Polygonum hydropiper	*Water pepper*
Polygonum punctatum	
Polygonum strigosum	
Ranunculus sceleratus	*Celery-leaved buttercup*
Ranunculus trichophyllus	*Water buttercup*
Rorippa nasturtium-aquaticum	*Watercress*
Rorippa sylvestris	
Rubus fruticosus agg.	*Blackberry*
Salix babylonica	*Weeping willow*
Salix cinerea	*Grey willow*
Salix fragilis	*Crack willow*
Salix matsudana	*Tortured willow*
Scientific Name	**Common Name**
Flowering plants–monocots	
Alisma plantago-aquatica	*Water plantain*
Aponogeton distachyus	*Cape pondweed*
Carex ovalis	*Oval sedge*

Carex ovalis	*Oval sedge*
Cortaderia selloana	*Pampas*
Egeria densa	
Eichhornia crassipes	*Water hyacinth*
Elodea Canadensis	*Canadian pond weed*
Festuca arundinacea	*Tall fescue*
Glyceria declinata	*Glaucous sweet grass*
Glyceria fluitans	*Floating sweet grass*
Glyceria maxima	*Reed sweet grass*
Glyceria striata	*Floating sweet grass*
Hydrilla verticillata	
Iris pseudacorus	*Yellow flay iris*
Lagarosiphon major	*South African oxygen weed*
Paspalum distichum	*Mercer grass*
Paspalum vaginatum	*Saltwater paspalum*
Phalaris arundinacea	*Reed canary grass*
Phragmites australis	*Common reed*
Potamogeton crispus	*Curled pondweed*
Spartina anglica	*Spartina*
Spirodela punctata	*Purple-backed duckweed*
Vallisneria spiralis	
Wolffia australiana	
Zantedeschia aethopica	*Arum lily*
Zizania latifolia	*Manchurian wild rice*

Appendix 4: List of tangata whenua and other contacts

Name (iwi/hapu affiliation)	Title/Area of interest	Address
Sonny Wara Tainui Ngati Naho	Chairman Ngati Naho Cooperative Society Limited Tangata Whenua Ngati Naho tribal rohe Whangamarino wetland	Ngati Naho Hapu Cooperative Society Limited 60 Te Puea Ave Meremere Ph: 09 233 6735 Ph: 09 233 6077 Fax: 09 233 6706
Malcolm Wara Tainui Ngati Naho	Projects Iwi research and environmental management Ngati Naho Whangamarino wetland Monitoring, management, and restoration of wetlands	Ngati Naho Ngaruawahia Ph: 07 824 7898 027 220 5250 Email: arana@quicksilver.net.nz
Rima Herbert Tainui Ngati Naho	Manager Ngati Naho Cooperative Society Limited Ngati Naho services Whangamarino wetland Monitoring, management, and restoration of wetlands	Ngati Naho Cooperative Society Limited 60 Te Puea Ave Meremere Ph: 09 233 6735 09 233 6077 Fax: 09 233 6706 Email: nhapu.meremere@xtra.co.nz
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Danny Roberts Tainui	Iwi projects Makaurau kaumatua Oruarangi awa/wetland Tamaki Makaurau Maori resource managers	Makaurau Marae Auckland
Mere Roberts	Lecturer Biological sciences Maori knowledge	SEMS Private Bag 92019 Tamaki Campus University of Auckland Auckland Ph: 09 373 7599

Appendix 4: List of tangata whenua and other contacts (continued)

Name (iwi/hapu affiliation)	Title/Area of interest	Address
Karl Flavell Ngati Te Ata (Tainui/Waiohua)	Resource management Ngati Te Ata kaitiaki Wetland restoration Environmental projects	Ngati Te Ata kaitiaki PO Box 437 Pukekohe Ph: 09 238 1495 (work) Ph: 09 238 3873 (home) E-mail: Flav@xtra.co.nz
Peter Temoananui Hauraki	Iwi research and environmental projects Resource management Firth of Thames (RAMSAR site) Environmental projects Management of wetlands	Hauraki Maori Trust Board PO Box 33 Paeroa Ph: 07 862 7521 E mail: Peter@haurakimaori.co.nz
Gayle Leaf Ngati Rauhoto, Ngati Tuwharetoa	Hapu researcher Cultural heritage Environmental projects	Taupo District Council E mail: gleaf@taupodc.govt.nz
Tui Warmenhoven Ngati Porou	Iwi researcher Environmental and cultural projects Environmental lawyer	Te Whare Wananga o Ngati Porou PO Box 121 Ruatorea Ph: 06 864 8884 Direct: 06 864 8981 E mail: TWWONP.RUATORIA@xtra.co.nz
Arapine Walker Te Arawa	Environmental consultant/projects/networks	Whaihua Consultants PO Box 120-34 Rotorua Ph: 07 3572 188 Email: arapine@xtra.co.nz
Terry Smith Nga Puhi, Ngati Raukawa	Environmental consultant/projects/networks	Whaihua Consultants PO Box 120-34 Rotorua Ph: 07 3572 188
Gary Wehipeihana Ngati Raukawa Ngati Tukorehe	Maori concepts Maori knowledge Maori land Environmental projects	Tukorehe marae, Ohau
Huhana Smith Ngati Raukawa Ngati Tukorehe	Environmental projects Wetlands Maori cultural values	Te Papa Tukorehe marae, Ohau E-mail: HuhanaS@tepapa.govt.nz

Appendix 4: List of tangata whenua and other contacts (continued)

Name (iwi/hapu/runanga affiliation)	Title/Area of interest	Address
Don Morrison Te Arawa	Projects Coordinator NZ Landcare Trust	12 Kauri Place RD 9 Te Puke Ph: 07 533 2030 E mail: DonM@landcare.org.nz
Kei Merito	DOC Whakatane Kaupapa Atawhai Manager	07 349 7400 025 855 834
Keni Piahana	Maori Regional Representation Committee Iwi classifications	80 Ranganui Road RD5 Tauranga Ph: 07 544 0852
Tony Wihapi	Iwi environmental projects	Te Roopu Manaaki Te Puke Ph: 07 573 4820 Home: 07 573 8559
Mike Mohi	Nga Whenua Rahui, DOC	Waipukurau Ph: 06 857 7358 Mobile: 025 246 6200
Julie Black Tuhoe	Manager Nga Whenua Rahui, DOC	Department of Conservation PO Box 10-420 Boulcott Street Wellington Jblack@doc.govt.nz
Caleb Royal Ngati Raukawa	Environmental projects Management plans and policy Te Whare Wananga o Raukawa	Te Whare Wananga O Raukawa Otaki Email: caleb.royal@twor-otaki.ac.nz
Dr Murray Parsons Ngati Kahungungu	Botanist Maori researcher	242A Main Rd Moncks bay Christchurch Ph: 03 384 9998 Email: parsons_whanau@lynx.co.nz
Lorraine Stephenson Rangitane	Iwi projects Biodiversity Resource management/Conservation QEII Trust, DOC	Rangitane o Tamaki Nui A Rua Inc. Society Dannevirke Ph: 06 374 6860 Ph: 06 374 5334; 025 320 923 E-mail: tamakinuiarua@rangitane.co.nz

Appendix 4: List of tangata whenua and other contacts (continued)

Name (iwi/runanga affiliation)	Title/Area of interest	Address
David O'Connell Ngai Tahu	Projects Coordinator Natural Resources Unit Te Runanga O Ngai Tahu	Ngai Tahu Group Management Ltd. Te Waipounamu House PO Box 13-046 158 Hereford Street Christchurch Ph: 03 366 4344 E-mail: David E-mail: david@ngaitahu.iwi.nz
Aaron Leith Ngai Tahu	Natural Resources Officer Te Runanga O Ngai Tahu	Ngai Tahu Group Management Ltd. PO Box 13-046 Christchurch Ph: 03 366 4344
Gail Tipa Ngai Tahu	Researcher Iwi issues Environmental monitoring Community participation Adaptive management	115 Main South Road East Taieri OTAGO Ph: 03 489 4534 Cell phone: 027 224 8061 E mail: gtipa@xtra.co.nz
Kelly Davis	Maori concepts Maori knowledge Environmental projects	
John Panirau	Maori concepts Maori knowledge Environmental projects	
Cath Brown Te Taumutu Runanga	Weaving, harakeke from wetlands, health and condition of wetlands Management of wetlands Te Waihora	C/-Taumutu Marae Pohau Road Taumutu Canterbury
Don Brown Te Taumutu Runanga	Monitoring and management of wetlands Matauranga Maori Te Waihora	C/-Taumutu Marae Pohau Road Taumutu Canterbury

Appendix 4: Other contacts for Maori environmental monitoring

Name (iwi/hapu/organisation)	Title/Area of interest	Address
Riki Ellison	Manager Maruwhenua section Ministry for the Environment	Ministry for the Environment 84 Boulcott Street PO Box 10-362 Wellington Ph: 04 498 7400
Tack Daniel	Maruwhenua section Ministry for the Environment	Ministry for the Environment 84 Boulcott Street PO Box 10-362 Wellington Ph: 04 498 7400
Hamish Wilson	Ministry for the Environment Maori indicators	Ministry for the Environment 84 Boulcott St PO Box 10–362 Wellington E mail: hamish.wilson@mfe.govt.nz
Antoine Coffin	Maori Planner – Resource management, cultural heritage, environmental monitoring Auckland Regional Council	Auckland Regional Council http://www.arc.govt.nz Ph: 09 366 2000 x 8093 Fax: 09 366 2155 E-mail: antoine.coffin@arc.govt.nz
Chris Koroheke	Iwi policy and planning Environmental projects Biodiversity Environment Waikato	Environment Waikato Hamilton E-mail: chris.koroheke@ew.govt.nz

Appendix 4: Other contacts for wetlands

Name	Title/Area of interest	Address
Bruce Clarkson	Botanist Lecturer	University of Waikato E-mail: b.clarkson@waikato.ac.nz
Bev Clarkson	Wetland scientist	Landcare Research Private Bag 3127 Hamilton E-mail: bev@landcare.cri.nz
Willie Shaw	Ecologist Natural resource management Bay of Plenty	5B Owhata Rd PO Box 7137 ROTORUA Ph: 07 345 9017 E-mail: wildland@wave.co.nz
Brigitte de Ronde	Manukau City Council Planner Oruarangi wetland restoration project	Manukau City Council E mail: bderonde@manukau.govt.nz
Johanna Taylor	Environment Bay of Plenty Wetland projects Wetland restoration	EnvBOP Whakatane Email: Johanna@envbop.govt.nz
Melanie Dixon	Policy Advisor Wellington Regional Council	Wellington Regional Council PO Box 11-646 Wellington E-mail: Melanie.Dixon@wrc.govt.nz
Shona Myers	Planning Auckland Regional Council	Auckland Regional Council E-mail: smyers@arc.govt.nz
Karen Denyer	Ecologist Wetlands Waikato region	Environment Waikato PO Box 4010 Hamilton E-mail: karen.denyer@ew.govt.nz
Colin Meurk	Ecologist Wetland restoration Canterbury region	Landcare Research PO Box 69 Lincoln E-mail: MeurkC@landcareresearch.co.nz

Appendix 5: Maori environmental monitoring sheet

MAORI INDICATORS – WETLAND MONITORING FORM

Name of wetland:
Date:
People involved in monitoring:

WHAT'S CAUSING THE PROBLEMS?

% area of land uses/riparian factors affecting Cultural Values

0 = 0%	1 = 1–20%	2 = 21–40%	3 = 41–60%	4 = 61 – 80%	5 = 81–100%

No. of point (sites) sources of pollution degrading ***te Mauri***

0 = 0	1 = (1–2)	2 = (3–5)	3 = (6–9)	4 = (10–14)	5 = (>15)

Degree of modification (drainage, water table, burning, in-flows, out-flows) degrading ***te Mauri***

1 = low	2 = moderate	3 = high	3 = v.high	5 = extreme

No. of exotic (introduced, foreign) plants, algae, animals, fish, birds (pest types) affecting Cultural Values

0 = 0	1 = (1–2)	2 (3–5)	3 (6–9)	4 (10–14)	5 (>15)

TAONGA AND MAURI? (Maori information about the wetland, its attributes)

No. of ***taonga*** species (flora and fauna) within wetland

0 = 0	1 = (1–2)	2 (3–5)	3 (6–9)	4 (10–14)	5 (>15)

% area of ***taonga*** plants within total wetland

0 = 0%	1 = 1–20%	2 = 21–0%	3 = 41–60%	4 = 61–80 %	5 = 81–100%

% area of exotic (introduced, foreign) plants covering total wetland

0 = 0	1 = 1–20%	2 = 21–40%	3 = 41–60%	4 = 61–80%	5 = 81–100%

No. of cultural sites within or adjacent to wetland

0 = 0	1 = (1–2)	2 (3–5)	3 (6–9)	4 (10–14)	5 (>15)

Assessment of ***te Mauri*** (scale)

1 = weak or low	2 = average or moderate	3 = strong or high

TRENDS/CHANGE/WETLAND GETTING BETTER OR WORSE?

Previous assessment date: **Present assessment date:**

Change in No. of *taonga* (flora and fauna) species within total wetland area
(+, same or &)

0 = 0	1 = (1–2)	2 (3–5)	3 (6–9)	4 (10–14)	5 (>15)

Change in % area of ***taonga*** plants within total wetland area
(+, same or &)

0 = 0%	1 = 1–20%	2 = 21–40%	3 = 41–60%	4 = 61–80%	5 = 81–100%

Change in % area of exotic (introduced, foreign) plants covering total wetland
(+, same or &)

0 = 0%	1 = 1–20%	2 = 21–40%	3 = 41– 60%	4 = 61–80%	5 = 81–100%

No of **cultural sites protected** within or adjacent to wetland

0 = 0	1 = (1–2)	2 (3–5)	3 (6–9)	4 (1– 14)	5 (>15)

Assessment of change in ***te Mauri***

1 = worse	2 = same	3 = improvement

Or

1 = negative/fast	2 = negative/slow	3 = neutral	4 = positive/slow	5 = positive/fast

Other comments about the wetland (e.g., use of wetland, customary access, customary rights, fitness for traditional cultural usage)