

Reference: Harmsworth, G.R.; Tipa, G. 2006: Māori Environmental Monitoring in New Zealand: Progress, concepts, and future direction. Report for the Landcare Research ICM web site.

Māori Environmental Monitoring in New Zealand: Progress, concepts, and future direction

GARTH HARMSWORTH AND GAIL TIPA

ABSTRACT

Environmental monitoring is a concept that follows international approaches and agreements to monitor and report on the state of the environment (SOE). In New Zealand, in line with these concepts, the development of environmental indicators began in the early 1990s. Reasonable progress has been made on the development of approaches, information systems, and datasets to support state-of-the-environment reporting both at regional and national levels. Māori environmental monitoring approaches have been developed to complement and contribute to mainstream SOE monitoring and reporting. This paper draws together Māori environmental monitoring ideas, concepts and approaches that have been developed to date, reports on progress, and discusses the likely future direction, and scenarios.

ABOUT THE AUTHORS

Garth Harmsworth is an environmental scientist with Landcare Research, NZ, located on Massey University Campus Palmerston North (HarmsworthG@LandcareResearch.co.nz) and has tribal affiliations to Te Arawa, Ngāti Tuwharetoa, and Ngāti Raukawa.

Gail Tipa is a honorary research fellow at Otago University and has tribal affiliations to Ngai Tahu (gtipa@xtra.co.nz)

Introduction

Environmental monitoring is regarded internationally as an essential framework, approach and set of tools that can provide information on the state of health of the planet by integrating data upwards from sites, ecosystems, provinces, and countries. To be effective monitoring should therefore engage population groups such as agencies, specialists and communities to report information about their environment at appropriate scales at regular periods in time. The idea of monitoring was a response to a multitude of complex issues including climate change, the hole in the ozone layer, depleting fresh water resources, water pollution, industrial pollution, decreasing biodiversity – including large-scale indigenous forest clearance, land degradation, waste management, urban sprawl – such as congestion and associated pollution, local human health issues, and depletion and degradation of marine and coastal resources. After the Rio Earth Summit in 1992, the need for some type of coordinated environmental monitoring and reporting framework gained impetus through many international meetings and conventions but has waned in the early part of the 21st century, as attention focussed instead on sustainable development and other world issues such as poverty and social equity. Signatories to Agenda 21 agreed to monitor and report on the status of their countries environments to provide early warning of problem areas, monitor change, and indicate progress towards desired goals. Data from

each country would then be aggregated to provide better understanding of what was happening at a global level.

It is likely, in the early 21st century, that sustainable development will provide the main context for environmental monitoring, and that monitoring will be much wider than just the environment, and will need to consider economic, social and cultural dimensions (Harmsworth et al. 2002). Systematic and widespread monitoring of the environment has yet to become a reality, and approaches still tend to be piecemeal and uncoordinated. Globally, however, the development of environmental indicators to measure trends and change for different parts of the environment, such as ecosystems, has progressed steadily. The environmental indicator programme in New Zealand (MfE 1997b) has continued, albeit now on a reduced scale, with a large number of monitoring approaches trialled, evaluated and documented, with the assembly of national and regional datasets to underpin reporting, and with a large amount of national and regional information documented through state-of-the-environment reports.

Environmental, cultural assessments and monitoring

Internationally, environmental assessment and monitoring have become requirements to report on the state of the environment (SOE) and to promote sustainable development. Countries, often through international trade and environmental agreements, as well as national and regional environmental standards, are increasingly being asked to collect information from different parts of the environment (MfE 1997b; Harmsworth 2002a; Stephens et al. 1999a,b) and report on good environmental practice and the sustainable management of natural resources. In New Zealand the responsibility to establish an environmental monitoring programme has been led and funded at the national level by the Ministry for the Environment (MfE), while requirements to monitor the environment are given to all regional and district councils under the Resource Management Act 1991.

Assessment and monitoring typically uses indicators to measure trends and progress through time towards desired goals and outcomes, establishing baselines and defined standards for each indicator to measure and detect change. Monitoring approaches are often used to determine effects, provide for comment on resource management activities, and to help with decision-making. MfE defined an EPI as a measure (e.g., distance from goal, threshold, benchmark) against which some aspects of policy performance can be assessed. Indicators were often referred to as the “signposts for sustainability” (MfE 1997b, 1998a) and were to be used against a reference point, to gauge the significance of the change, either statistically or through some form of quantitative or qualitative analysis. Monitoring needs to be regular to measure or observe trends or sudden changes in the state of an environmental system, population, or individual (MfE 1997b, 1998a). Monitoring can also be used to track changes in the way people value the environment, and cultural values can be very important factors for setting environmental standards, goals, and guidelines that point towards or away from some type of natural or culturally acceptable state.

The main international model to assess environmental change and report on the state of the environment, first used by the Organisation for Economic Cooperation and

Development (OECD 1993, 1997), is the pressure–state–response (P–S–R) framework. It placed environmental monitoring into a policy and management framework (Dymond et al. 2001). The model was organised into three main groups:

- pressure indicators – an environmental stress or pressure (e.g., land use, land-use activity)
- state indicators – an independent or state indicator (e.g., water quality, erosion)
- response indicators – 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.

Most development of environmental indicators and monitoring approaches in New Zealand have used the P–S–R model as part of the national environmental performance indicators (EPI) programme (MfE 1997b, 1998a). Indicators within the framework can be used to benchmark an acceptable standard that shows whether the environment is getting better or worse (Morgan-Williams & Mulcock 1996).

Māori participation in environmental monitoring

Background

Māori have been observing and interacting with their environment for centuries. The traditional Māori worldview acknowledged a natural order to the universe, built around the living and the non-living, and the central belief was that all parts of the environment were interrelated or interdependent through the domains of Atua or departmental gods. Traditionally, Māori believed that small shifts in the mauri or life force of any part of the environment, for example through use or misuse, would cause shifts in the mauri of immediately related components, which could eventually affect the whole system. All activities and relationships with the environment were governed by mythology, religion, and Māori values. Within this framework spiritual qualities guided resource use through an elaborate system of ritenga or rules, with goals to regulate and sustain the wellbeing of people, communities and natural resources. Guiding values and concepts included *kaitiakitanga*, *tapu*, *mauri*, *rahui*, *mana*, *noa*, and *wairua*.

The requirement to introduce more systematic and defensible monitoring standards within national and international frameworks is a recent phenomenon. Māori were invited to participate in the national MfE environmental indicator programme in 1998, through reference groups, forums and related projects. This was primarily to provide background to key concepts and frameworks that could establish a role for Māori in environmental monitoring, and provide a cultural perspective and ways to engage Māori communities and organisations, such as iwi and hapū, in environmental monitoring. The need to incorporate Māori perspectives and aspirations in environmental monitoring was supported at various levels and under legislation.

To ascertain the Māori role in monitoring, we use the premise that Māori have different beliefs, values, and cultural perspectives from mainstream western thinking. A different world-view may change the way people experience, perceive, and interpret their environment and their relationships with other people, and may change the way Māori

approach an issue. In the context of national monitoring and reporting it was important to ask questions such as:

- How do Māori therefore see their environment changing in time? Define issues? Prioritise work?
- How do Māori assess and monitor their environment?
- How do Māori assess change and define environmental health?
- What is Māori knowledge? What are Māori concepts and beliefs?
- How can Māori knowledge be used to underpin assessment and monitoring?
- How do Māori make decisions about their environment?
- How do Māori define what is an ideal relationship with local government, and other agencies?
- What are Māori environmental and cultural aspirations?

Many of the answers to these questions require an in-depth understanding of tikanga, cultural values, and models of Māori governance and environmental management.

Key Māori concepts

Contemporary Māori values in environmental management are based on a mix of the traditional and the modern, and form the basis for Māori environmental monitoring, management, and decision-making. Traditional concepts, whilst utilising modern research and science, are central to the development of iwi and hapū planning and environmental monitoring approaches. For iwi and hapū, values and cultural perspectives help develop standard forms of interpretation that provide the framework for much of their resource management work. These frameworks have helped Māori articulate the way they interpret their present environment, the issues they contend with, how they assess effects, how they measure change, and how they process information and arrive at decisions. Examples include: prioritising issues, cultural understanding of adverse effects, assessing cultural impact, planning to protect and manage culturally significant areas, and planning restoration and enhancement projects. Cultural frameworks therefore help with resource management issues, decision-making, assessment of cultural impacts and environmental change, state of environment reporting, the management and allocation of resources, and the identification and prioritisation of projects that can achieve Māori aspirations and advancement. For local and central government, understanding values, issues, cultural perspectives, and Māori aspirations has been an essential first step to building relationships with iwi and hapū (Harmsworth 2001, 2003, 2005).

For Māori, assessment and monitoring can therefore be used to assess cultural health as well as environmental change. For those working in resource management, it is increasingly important to have effective and defensible systems and approaches in place for environmental and cultural assessment, as well as methods for monitoring, interpreting, and reporting on cultural and environmental impacts, usually linked to cultural values.

Tangata whenua values (TPK 1993; TWOR 1998) are the underlying cornerstone for all sustainable resource management, decision-making, and the development of monitoring tools. Some of the key concepts include:

- Whakapapa
- Mana whenua (status, authority, prestige over a defined area)
- Kaitiakitanga (guardianship)
- Maintenance of the mauri in all component parts of the system and striving for balance
- Understanding that all parts of the environment are interrelated and using a whole system approach, understanding cause and effect, cumulative effects
- Tau utuutu, the principle of reciprocity, giving back what you take
- Recognition and use of mātauranga Māori
- Action and association
- Constant recognition and acknowledgement that the big picture needs to be understood
- Awareness that human activities and values are central to issues and need to be understood in order to solve problems.

Māori participation in the MfE EPI programme

In the late 1990s MfE developed a “three-tier approach” for Māori input into the national EPI programme (MfE 1998b, 1999a). A large number of projects were completed as part of this approach:

- an independent Māori advisory panel report (MfE 1998b)
- strand by strand contracts (Gardiner & Parata 1998a,b)
- three main Māori ecosystem case studies (MfE 1999a): the marine methods and indicators for marine protection (DOC 2001, 2003a,b); mauri and mahinga kai indicators (Tipa, 2002, Tipa & Tierney 2003); and the kaimoana survey guidelines for hapū and iwi (MfE 2003).

In addition, a number of other Māori projects have been carried out independently or through the sustainable management fund (SMF) managed by MfE. Some of the early participation of Māori in the EPI programme helped establish Māori conceptual frameworks for indicators and monitoring and the panel of independent Māori set up in 1998 (MfE 1998b) completed the following tasks:

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

The information from these early hui were documented in the report “Māori Environmental Monitoring” (MfE 1998b), which provided a useful basis for developing conceptual approaches for identifying MEPIs. The Māori advisory panel, through a series of hui and discussions, developed frameworks within which Māori could monitor the environment, define the concept of a MEPI, and provide examples of generic MEPIs, along with concerns and issues that should be considered during the identification of MEPIs. The panel developed a partnership model while carrying out this work that advocated 3 discrete independent houses: a “Tikanga or safe Māori working environment”; a “Crown or Pakeha house” that represented Government or Crown

departments; and a “Treaty House”. The bi-cultural “Treaty House” was used by the Treaty partners to conduct affairs, discuss issues, etc., in partnership (MfE 1998b). In the early stages of the work the Māori panel located itself in the “Tikanga Māori House” before taking results into the Treaty House.

Conceptual frameworks for Māori environmental monitoring

Within the national EPI programme, Māori frameworks were established to provide a context for the identification, development and application of MEPIs. The Māori advisory panel in 1998 proposed 2 main Māori frameworks (MfE 1998b):

- The Mana Whenua framework: orientates a Māori community towards planning for their environment independently of external considerations and concerns.
- The Integrating framework: recognises that Māori need to monitor the environment along with other kinds of groups such as Crown agencies; and requires Māori communities to plan independently within their environment, before integration.

These two frameworks were based on the definition of “Primary Māori groupings” and “secondary Māori groupings”, as summarised below:

- Primary Māori groupings – relationship with environment is drawn from whakapapa, e.g., tangata whenua, mana whenua
- Secondary Māori 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.

Definition of a Māori Environmental Performance Indicator

From early work on Māori environmental indicators, largely as part of the EPI programme (MfE 1997, 1998a), the Māori advisory panel was asked to provide a concept and definition of a Māori environmental performance indicator or MEPI (MfE 1998b). This concept evolved from a series of “ideas” and culturally based concepts, and the following definition was given:

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

Groups of Māori EPIs

A number of ideas were first proposed regarding the main groups of Māori EPIs that could be developed or identified (Tuanuku Consultants 1998; MfE 1998b, 1999a). In 1998 the MfE Māori panel first proposed two broad groups of environmental performance indicators:

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

- Anthropocentric (people-centred): for example, human ecology based cultural indicators (i.e. knowledge from traditional Māori phenomena that define environmental relationships), including kaitiakitanga, mauri, whakapapa, whānaungatanga, tapu, and wahi tapu.

Examples of MEPIS

From the 2 main broad groups above, examples of Māori indicators, or suites of indicators, were given (Tuanuku Consultants 1998; MfE 1998b, 1999a) and subsequently expanded by other workers in this area (e.g., HMTB 1999; Tipa 1999, 2002; Tipa & Teirney 2003; Harmsworth 1999, 2002d). It was increasingly evident that Māori had a strong interest in monitoring customary or taonga species (e.g., Tau et al. 1990; TPK 1993; Waitangi Tribunal 1991; TRONT 1998), either generic or specific to hapū and iwi groups. Species indicators (e.g., Strickland 1990) may include something about what is there, something about the quantity, and something about quality (MfE 1998b), as well as:

- presence of customary or taonga species
- quantity of customary or taonga species
- quality/condition of customary or taonga species

These concepts were further developed, for example, by Harmsworth (1999, 2002b,c,d), in wetland systems to identify the:

- presence and spatial extent, such as presence and spatial extent of culturally significant species (e.g., based on Māori 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., an assessment of mauri, what's degraded?, assessment of health, Māori classifications).

Along with the wetlands work, the cultural health index (CHI; Tipa & Teirney 2002, 2003) was developed to provide iwi/hapū with a tool to express their cultural perspectives, values, and past and ongoing relationships with an area. The CHI provides a holistic Māori perspective of stream and river health. These monitoring methods represent important Māori approaches that enable reporting on the state of the environment and make a valuable contribution to research areas including integrated catchment management, biodiversity, sustainable resource management, and effects based planning. In terms of monitoring to reflect cultural values, Māori expressed interest in five main groups of indicators (Harmsworth 1999, 2002d; Tipa & Teirney 2002, 2003):

- Presence and absence of culturally significant flora and fauna species (e.g. plant, bird, fish) that indicate to Māori whether the environment is healthy, provide an assessment of mauri, and reflect the degree to which iwi and hapū values are being expressed or represented. These were essentially indicators Māori wanted to see more of in an area, and were grouped as *taonga species*.

- Presence/abundance of pests or “unwanted flora and fauna”, usually foreign, exotic or introduced plants, animals, bird and fish species. Most iwi and hapū representatives wanted to see less of these indicators in and around sites, as they associated them with reducing health or mauri. These unwanted or foreign indicators were generally equated with environmental stress, degradation, pollution, negative effects on mauri, and other problems.
- A measure or assessment of mauri (Black 1994; life force, internal spirit or essence of life) was regarded as very important to all iwi and hapū, tangata whenua (Tipa 1999; Harmsworth 2002b,d; Tipa & Teirney 2003). It is necessary for Māori in any assessment to be able to express their relationship, value and wairua with a place in 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 a site, a mauri assessment provides a holistic approach to assess not only the site itself but also its relationship with tangata whenua, and other people, and how they interact and use the site. Mauri also assesses the catchment area around the site (e.g., wetland, river, stream), taking into account various impacts of human activity, both historic and present. The health of a site needs to reflect Māori values and knowledge, whakapapa, and the spiritual relationships tangata whenua have with a particular area.
- Indicators of water quality, pollutants (e.g. , industrial, roads), contaminants (e.g., sewage disposal), both from point and spatial areas – including freshwater and coastal pollution – reflecting a decrease in quality, condition, or health of an area, usually requiring mitigation, remediation, rehabilitation or repair
- An assessment of cultural heritage indicators that further establishes and identifies connection and relationship between iwi and hapū to a site. This may include wahi tapu, and wahi taonga sites such as paa, marae, kainga, etc. Many iwi and hapū individuals were interested in reporting the level of protection and management of particular areas or sites, and the present degree of modification to cultural sites.

Criteria for selecting an effective Māori indicator

It was very important at the onset of all projects to list the key criteria that determine “an effective Māori environmental performance indicator”. A number of important criteria have guided the development of Māori indicators and most reports refer to the need for simple, robust, meaningful, and defensible indicators that can be monitored cost effectively. From previous MfE literature (MfE 1998b, 1999a; Tuanuku Consultants 1998) and subsequent work (Tipa 1999, 2002; Tipa & Teirney 2002, 2003; Harmsworth 1999, 2002d) descriptions and criteria stipulated that effective Māori indicators should be:

- based on tikanga (follows iwi or hapū rules and values)
- based on information that is still available/obtainable (e.g., mātauranga Māori, knowledge that still exists)
- meaningful to tangata whenua/iwi/hapū/rūnanga

- able to be assessed/measured and interpreted by both by local and other Māori groups
- cost-effective
- repeatable and consistent
- 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 environments, and be 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.

Having the right social and cultural environment

For Māori to participate effectively in environmental monitoring programmes it is necessary to have the right social and cultural environment or framework. In response to a number of factors (e.g., national EPI programme, settlement of Treaty Claims, resource management activities, cultural heritage, responsibilities of kaitiakitanga), Māori researchers became increasingly involved in systematic indicator research in the latter part of the 1990s. Once key concepts and frameworks were established it was recognised that key factors needed to be in place before identifying, developing and using MEPIs in a monitoring programme. This has been reiterated in a number of iwi and hapū management plans (e.g., TROK 2005). Harmsworth (1999) identified a large number of critical factors in the national wetlands project that helped guide the development of indicators:

- understanding and adherence to tikanga, cultural protocols, custom, process, procedure
- prior knowledge – an available Māori knowledge source, access to relevant knowledge and information held by tangata whenua/rūnanga representatives (e.g., based on mātauranga Māori, environmental knowledge from a Māori perspective)
- appropriate MEPI frameworks in which to work
- capacity and resources (e.g., funding, skilled people, key individuals)
- organisation and leadership
- access to scientific information and knowledge/national and regional databases/expertise
- communication, coordination, collaboration, and trust (e.g., community or hapū based)
- access to areas, natural resources, ecosystems, environmental domains
- Māori classification systems and organisational frameworks for collecting and recording information
- an appropriate and consistent methodology
- understanding MEPIs and their relevance to providing information on environmental change and trends, agreement and understanding on why monitoring should be carried out
- ability to interpret, analyse, synthesise and integrate information

- regard for intellectual property rights, a system, process, acknowledgement to information sources, agreement or protocol to collect, record, and store sensitive or confidential information
- ability to synthesise or aggregate selected MEPI information for community, tribal, regional or national state of the environment (SOE) reporting

Time frames

To identify change and trends, indicators need to be measured at regular intervals. Obviously this depends on the type of indicators and cost. Most time frames range from intervals of months to years. For national reporting it was recommended that a suitable national reporting time-frame, to identify and report on detectable environmental change, be repeated somewhere between 1 and 5 years. However, more regular or continual environmental monitoring by local community groups was also strongly advocated, to provide information on any ongoing or sudden deleterious change.

Māori monitoring approaches – projects

Alongside early Māori EPI work and case studies funded by the MfE EPI programme there have been a large number of other Māori projects that have made, or are making, a significant contribution to the development of tools and approaches for Māori environmental monitoring and SOE reporting. These include the: Taieri River case study (Tipa 1999), Hauraki Customary Indicators Report (Hauraki Trust Board 1999), Coordinated Monitoring of New Zealand wetlands (Harmsworth 1999, 2002d), the State of the Environment report Te Purongo Maniapoto (Kowhai Consulting Ltd and MfE 2002), and more recently the State of the Takiwa project developed by Te Rūnanga o Ngai Tahu (Mattingley and Pauling, 2005). In addition to these reports, a large number of other groups have referred to environmental monitoring in their iwi and hapū management plans (e.g., NIRMAK 2004; Dyanna Jolly pers. comm.; TROK 2005), in environmental projects (e.g., Mitchell et al. 1993; Kawakawa Charitable Trust 2001; Lucas Associates 2001), where iwi- and hapū-based monitoring methods, standards and frameworks have been described. Further, a large number of iwi and hapū groups have developed cultural impact assessments and several models exist (e.g., Walker et al. 2003, 2004; Tipa et al. 2002; Tipa & Associates 2004; TRONT 2005). There is an extensive list of Māori-led indicator and monitoring projects in both the North and South Island, for example, Te Wānanga O Raukawa and Ngāti Raukawa hapū (Pataka Moore, Caleb Royal pers. comm.) in both sand country, wetlands, and freshwater systems such as the Mangapouri stream at Otaki, and lower reaches of the Otaki river; Lake Horowhenua (Muaupoko iwi); Hokio Stream (Ngāti Pareraukawa & Muaupoko); Ngāti Kere near Porangahau (Jenny Mauger pers. comm.; Morry Black pers comm.; Dr James Ataria, pers comm.); Ngāti Konohi, Whangara (DOC 2003b); Te Tau Ihu iwi and hapū groups at the top of the South Island (Harmsworth 2003; NIRMAK, 2004), and numerous Ngai Tahu examples (Gail Tipa, pers. comm.; Craig Pauling, pers. comm.). Many of these Māori-led restoration and monitoring projects use oral history recordings of mātauranga Māori as a basis for developing monitoring approaches. More detailed or specific types of Māori environmental monitoring for specific environments (e.g., marine, coastal, fluvial, lakes, wetlands, terrestrial) have been designed and continue to be trialled, evaluated, and refined by several other groups in different parts of New Zealand. Some of the main

Māori environmental monitoring approaches now available to iwi, hapū, and Māori organisations, as well as associated scientific and technical tools that complement these approaches, are summarised below.

Cultural Stream Health Index

The Cultural Health Index (CHI; Tipa 2002, Tipa & Teirney 2002, 2003) for streams and waterways was developed as one of the MfE EPI case studies: mauri and mahinga kai indicators (MfE 2002). It was originally developed, trialled and evaluated in the Taieri and Kakanui catchments, Otago 1997–2003 (Tipa 1999), and more recently in the Tukituki river, Hawke’s Bay (2004–2005) by Ngāti Kahungunu researchers to test its applicability for other river types. The CHI was developed to give iwi/hapū a tool to express their cultural values of stream health and mahinga kai in a way that could be incorporated into catchment management decisions. The index comprises a score (e.g., A-1/2.9/4.1) for recognising and expressing Māori values, and as an indicator for environmental reporting. It can be used for entire river and stream catchments rather than solely for small sections or sites along a river/stream. Three components make up the numeric index at any given river or stream site:

- establishing the relationship or association by tangata whenua, iwi/hapū (site status)
- evaluating mahinga kai values (mahinga kai measure)
- assessing stream health (stream health measure)

The Māori wetland indicators project

The Māori wetland indicators project (Harmsworth 1999, 2002b,c,d) was part of a national project, Coordinated Monitoring of New Zealand Wetlands, funded under the MfE sustainable management fund (SMF) (UNEP/GRID 1999; Clarkson et al. 1999; Downs et al. 2000; Clarkson & Ward 2002; Clarkson et al. 2002). The project was designed to develop a national monitoring approach and classification for wetlands (Clarkson et al. 2002), and ran parallel to the MfE environmental performance indicators programme (MfE 1997, 1998a). Within this larger wetlands project, the Māori indicators objective developed a Māori approach for assessing wetlands together with a set of indicators, and was carried out using participatory research with a number of iwi and hapū throughout New Zealand. The P-S-R model (OECD 1993, 1997; MfE 1998a) was used to develop the main indicator groups and more specific or key indicators in each group. Within a participatory research framework the P–S–R model was explained as:

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

A final set of 9 key Māori indicators, largely based on mātauranga Māori, included mauri, taonga iconic species, % spatial area change, and perceived problem or exotic species. The indicators were strongly linked to assess progress towards desired cultural and environmental goals for wetland rehabilitation (Table 1) and can be applied to other environments where trends are measured, and goals determined. The indicators can be used from site to catchment scale. Methods can be used to complement other Māori and

scientific approaches and to support cultural impact assessments and long-term monitoring programmes.

Table 1. Taonga (iconic species) lists for assessing progress towards cultural and environmental goals (Harmsworth 2002d)

Taonga 1840–1880	Taonga – Present	Taonga – Future?
<p>Habitats – historic</p> <p>Tuna (<i>Anguilla australis</i>, <i>Anguilla dieffenbachii</i>)</p> <p>Inanga (<i>Galaxias spp.</i>)</p> <p>Paraki, rangiriri, Tikihemi (smelt) (<i>Retropinna retropinna</i>)</p> <p>Piharau (<i>Geotria australis</i>)</p> <p>Kōkopu (<i>Galaxias spp.</i>, <i>Galaxias fasciatus</i>, <i>G. masculatus</i>)</p> <p>Koaro (<i>Galaxias brevipinnis</i>)</p> <p>Kanae (<i>Mugil cephalus</i>)</p> <p>Paatiki (<i>Rhombosolea leporina</i>, <i>Rhombosolea plebeia</i>)</p> <p>Mohoao (<i>Rhombosolea retiaria</i>) black flounder)</p> <p>Koura, kewai (<i>Paranephrops planifrons</i>, <i>P. zealandicus</i>, <i>P. setosus</i>)</p> <p>Kākahi (<i>Hydridella menziesi</i>)</p> <p>Pipi (<i>Paphies australis</i>)</p> <p>Tuangi (<i>Protothaca crassicosta</i>)</p> <p>Wiwi (<i>Juncus</i>)</p> <p>Harakeke (<i>Phormium tenax</i>)</p> <p>Ti Kouka (<i>Cordyline spp</i>)</p> <p>Kuta (<i>Eleocharis sphacelata</i>)</p> <p>Raupo (<i>Typha orientalis</i>)</p> <p>Manuka, Kanuka (<i>Leptospermum scoparium</i>, <i>Kunzea ericoides</i>)</p> <p>Yellow Manuka</p> <p>Kahikatea (<i>Dacrydium dacrydioides</i>)</p> <p>Totara (<i>Podocarpus totara</i>)</p>	<p>Habitats present & condition?</p> <p>Tuna</p> <p>Inanga</p> <p>Paraki</p> <p>Pipi</p> <p>Tuangi</p> <p>Wiwi</p> <p>Manuka</p>	<p>Habitats? To re-establish taonga e.g.,</p> <p>Tuna (short and long-finned eel)</p> <p>Inanga (whitebait)</p> <p>Piharau (lamprey)</p> <p>Kōkopu (cockabully, giant bully)</p> <p>Koaro (native trout, common bully)</p> <p>Kanae (grey mullet)</p> <p>Patiki (sand flounder, yellow belly flounder)</p> <p>Koura, kewai (freshwater crayfish)</p> <p>Kākahi (freshwater mussel)</p> <p>Pipi (mollusc, shellfish)</p> <p>Tuangi (mollusc, cockle)</p> <p>Wiwi (rush)</p> <p>Harakeke (flax)</p> <p>Ti Kouka (cabbage tree)</p> <p>Kuta (spike rush, sedge)</p> <p>Raupo (bulrush)</p> <p>Yellow Manuka</p> <p>Manuka, Kanuka</p> <p>Kahikatea</p> <p>Totara</p>

The Kaimoana Survey Guidelines for Hapū and Iwi

The Kaimoana survey guidelines were completed as another of the MfE EPI case studies (MfE 2002). A set of comprehensive guidelines and a template for surveying and monitoring kaimoana from a Māori perspective was developed by Otaraua hapū, Waitara, in partnership with Shell New Zealand between 2000 and 2001 (MfE 2003). Other groups involved were Taranaki Regional Council and Ngāti Rahiri iwi. The guidelines, with reporting and monitoring templates, identified and illustrated a range of taonga indicator species. They provided a structured framework and method for hapū and iwi to work alongside a range of agencies with mutual interests, such as local government, industry, community and stakeholders groups, to manage marine and coastal resources sustainably.

Marine methods and indicators for marine protection

The marine methods and indicators for marine protection (DOC 2001, 2003a,b) case study was also initiated through the MfE EPI programme (MfE 2002). The case study, a joint MfE /DOC initiative, focussed on 2 main areas working with the hapū Ngāti Kere at Te Angiangi Marine Reserve near Porangahau in Hawke's Bay and Ngāti Konohi at Te Tapuwae o Rongokako Marine reserve near Whangara. The marine case studies selected sites for investigating the effect of protection on marine life and compared results with nearby unprotected sites. Hapū members were involved in the interview process to collect mātauranga Māori and in dive teams to assist marine scientists with monitoring and research. This involved collecting information on cultural values, baseline surveys, reef surveys, coastal inventories using habitat and species mapping, identification of icon (e.g., taonga) species, and identifying cultural indicators. Five main types of monitoring were recognised in these case studies:

- Biodiversity
- Visitor and recreational impact
- Commercial activity
- Visitor enjoyment and appreciation
- Effectiveness of policy.

Information from these types of studies is being used to help hapū and DOC meet objectives for monitoring and management. There have been a number of other examples given by hapū and iwi for marine and coastal monitoring, sometimes involving the integration of mātauranga Māori and western science, customary research and the development of oral archives, coastal inventories, and the preparation of workbooks and handbooks. Some of this work has involved hapū and iwi working with government agencies such as MFish and research agencies such as NIWA. Examples are also given of studies carried out in response to resource compliance for commercial business planning in coastal and marine environments (e.g., aquaculture).

Coastal–marine monitoring

Māori organisations such as iwi and hapū, kaitiaki groups, have immediate interests in survey and monitoring along the coastal margins and in the coastal–marine environment. A number of Māori groups have been involved in the development of coastal and marine

monitoring. Because Māori define ecosystems in a holistic way, these projects are not strictly marine or coastal, and include research, surveys and monitoring along beach, inter-tidal and sub-tidal areas. This type of work has been undertaken in the Hawke's Bay (e.g., Ngāti Kurukuru, Ngāti Whakaiti, Ngāti Hikatoa, Ngāti Urakiterangi at Waimarama, and Ngāti Kere at Porangahau), Gisborne-East Cape (e.g., Ngāti Konohi) Marlborough (e.g., Ngāti Koata), Cape Palliser (e.g., Ngāti Hinewaka), Taranaki (e.g., Otaraua hapū, Ngāti Rahiri), Northland (e.g., hapū o Nga Puhi, Ngāti Wai), and Bay of Plenty (e.g., Ngāti Awa, Te Whānau a Apanui). An extensive range of examples were cited for the Hawkes Bay (Jenny Mauger pers. comm.), for example several hapū of Ngāti Kahungunu have been involved in development of archives, interviews with kaumātua, kuia, and other groups, the development of databases, the definition of icon species, coastal inventories, sites of cultural significance databases, beach usage surveys, baseline surveys, surveys of exotic species, fish catch surveys, and workshops for customary fisheries and monitoring Work undertaking kaimoana surveys and the development of indicators is often culturally based but integrated with western science data collection (e.g., inventories, iconic species) and scientific monitoring in coastal, estuarine, and marine environments. A large number of cultural and environmental issues relate to coastal and marine environments and many iwi and hapū are using data from these studies to better define impacts on cultural resources and to help determine sustainable management of coastal resources. Understanding iwi and hapū issues in coastal marine environments can be used generate new collaborative research tailored for common areas of interest.

Cultural impact assessments

Cultural impact assessments (CIAs) are increasingly being carried out in New Zealand by Māori organisations and are important assessment tools for addressing complex resource management and cultural issues of a specific area. A large number of iwi and hapū groups have developed methodologies for CIA (e.g., Walker et al. 2003, 2004; Tipa et al. 2002; Tipa & Associates 2004; TRONT 2005). Assessments are usually organised into methods, process, background and issues. As tools they provide conceptual frameworks based on Māori values (Walker et al. 2003; TRONT 2005), a cultural perspective, a position statement by an iwi, hapū or Māori group. CIA documents often work in conjunction with iwi or hapū management plans and go onto make recommendations proposing how effects can be avoided, remedied, or mitigated (Walker et al. 2003, 2004; TRONT 2005). They articulate cultural perspectives and types of monitoring.

Resource consents

A large number of Māori organisations use resource consents to monitor environmental change. The processing, actions, and outcomes of consents is an effective method to identify the effects of human activity (e.g., residential and industrial development, roading, sewage and water reticulation networks, excavation of sites) on cultural values. Consents allow regular monitoring throughout the rohe to identify areas under pressure and change, and to formulate appropriate responses to this pressure through plans, policy and actions.

Iwi monitoring of cultural-heritage sites

A number of Māori organisations regularly monitor cultural heritage and archaeological sites. The work is often carried out with professional archaeologists, historians, and local government staff. Monitoring is fundamentally carried out to protect and manage specific cultural sites associated with and in response to a large number of issues related to human activity, development, built environments, etc.

Iwi monitoring of contaminated sites

A number of Māori groups, such as local hapū and iwi, are monitoring contaminated sites (e.g., Mapua). This can include collaborative research and investigation with local government and scientific organisations collecting and collating data on contaminants and materials at a site or in regard to remediation or rehabilitation of a contaminated site. Such monitoring also provides information as part of a CIA.

River and stream health monitoring

Several Māori groups throughout the country are monitoring river and stream health using technical indicators that are scientifically based. Examples include using tools such as the Stream Health Monitoring and Assessment Kit (SHMAK) developed by the National Water and Atmospheric Research (NIWA) in 1998 (NIWA 1998). It was developed for communities, iwi and researchers (e.g., training workshops and evaluation by regional Ngai Tahu groups in 2001) and when used regularly provides information on long-term trends for stream health, water quality, and ecological habitats and can be used to monitor effects of land-use activities. The methodology collects information on water quality and physical features of the stream, including plants and animals and uses a scoring system for data analysis.

Many councils working with iwi use standard methods to assess water quality and habitat opportunities, such as species richness, species abundance, the macro-invertebrate community index (MCI) and the quantitative macro-invertebrate community index (QMCI) (MfE 1999b; Boothroyd & Stark 2000), and a few iwi groups are using MCI or QMCI especially in combination with cultural approaches such as the CHI. For example, the Ngātiwai Trust Board Resource Management Unit, Whangarei, conducts regular macro-invertebrate surveys in its rohe. The MCI assesses stream health based on the presence or absence of certain types of invertebrate on the stream bed, which differ in their ability to tolerate degradation of water quality such as caused by pollution. Healthy streams have a high values of MCI (e.g., $\sim >120$) while unhealthy streams have low values (e.g., $\sim <80$).

Other Māori and community groups are using a variety of assessment forms such as the stream health field assessment approach a waterway self-assessment form (Polglase & Death 1998). The form, developed with support from Federated Farmers and the Manawatu–Whanganui Regional Council in 1998, is designed as a simple assessment to pinpoint problem areas of waterways and monitor management progress. It also gives some indication of stream health. The assessment is in the form of a scoresheet for a specific stream or area of a stream.

Scientific monitoring

Many iwi and hapū groups are building their capacity to be engaged both in cultural and scientific monitoring (Table 2) of terrestrial, fluvial, coastal and marine environments or defined Atua domains. This often involves acquiring or collecting information on biological, chemical and physical parameters for a range of ecosystems.

Table 2: Examples of scientific and technical indicators for water quality monitoring

BOD – Biochemical oxygen demand	Organo-chlorines
DO (mg/L) – dissolved oxygen	
DO (% Saturation) – dissolved oxygen	Chlorophyll a
Temperature	Water Clarity
Conductivity – electrical current	Visual Clarity
pH – measure of acidity vs alkalinity	Dissolved colour
Turbidity – e.g. sediment, water clarity	Total Suspended solids
Flow at gauged and un-gauged sites	E. Coli (<i>Escherichia Coli</i> bacteria)
Nutrients (DRP, TP, NO ₃ -N, TN, NH ₄) – phosphorus, nitrogen, ammonia	Campylobacter (bacteria)
Total Nitrogen	Faecal coliforms
Nitrate – N	Enterococci
Ammonia	Giardia
Total Phosphorus	Cryptosporidium
Dissolved reactive P	Macroinvertebrates
Heavy metals – e.g., Arsenic, Boron, Lead	Periphyton

Biosecurity

A number of Māori organisations are interested in controlling and monitoring introduced or exotic species of fauna and flora – e.g., animals such as mammalian pests (e.g., possums, rodents, mustelids), birds, insects, plants. Much of this work has usually been an important component of restoration-rehabilitation, revegetation, and forest and indigenous ecosystem enhancement projects. Monitoring performance and progress towards desired cultural and ecological goals is essential. This usually relies on integrating customary or cultural methods with statistically robust scientific evaluation methods. Very few operational examples exist, but many Māori groups are working with Crown science and research agencies (Innes et al. 2004) and with the Department of Conservation (e.g., Omaio, Nga Whenua Rahui pers. comm.). This monitoring has been essential for the development of management and animal control strategies to help iconic bird species recover such as kiwi, kereru and kokako and iconic tree species such as pohutakawa and cabbage tree (ti kouka – *Cordyline spp.*). Many other iwi and hapū projects identify monitoring as a priority for reporting progress for controlling weeds and animal pests as part of restoration or rehabilitation projects (e.g., Kawakawa Charitable Trust 2001).

Sustainable customary harvest

Many Māori groups are interested in monitoring sustainable harvest or customary resource use for particular flora or fauna species. Most traditional monitoring methods used by indigenous cultures are culturally based, rapid, low-cost, pragmatic, and easily comprehended by these communities (Moller et al. 2004). In New Zealand most cited

examples comprise integrating customary or cultural methods with scientific methods and using methods that employ some form of statistical evaluation through time. There are limited examples of any regular or operational monitoring by Māori groups monitoring customary sustainable harvest of a species. Most examples include a science agency working with a Māori group to define the status of species populations and sustainable baselines. A much cited example was carried out in the Motatau forest, Northland (Innes et al. 2004) with Ngāti Hine to help kukupa or kereru species recover. There is also a strong interest from tangata whenua for increasing native bird populations to a level for customary and sustainable harvest under strict controls. This contentious goal has been vigorously debated with many environmental and scientific groups. Other work commonly cited in terms of sustainable customary harvest is the collaborative research led by Dr Henrik Moller (Moller et al. 2004) that has been carried out with Rakiura (Stewart Island) Māori for several years on Titi (*Puffinus griseus* – mutton bird) harvest. The Rakiura Titi population monitoring has used both traditional indigenous and scientific methods. Most titi harvesters use a range of indicators including catch rates and body condition. They have kept written records, corresponding with weather and moon conditions, going back decades to allow them to assess trends as a basis for sustainable management.

Urban environments

An increasing amount of Māori research is taking place within urban environments. Several projects started in the late 1990s to develop frameworks and indicators to measure progress towards goals of “healthy or quality urban environments. Since 2000, this has included Māori input, advice, leadership, projects, perspectives and the role of cultural values, for example, in: cultural heritage planning and policy; biodiversity; low-impact urban design and development; roading design; site contamination; restoration and rehabilitation of natural environments; Māori health, and wellbeing; storm-water; road run-off; waste management; Māori housing; and papakainga development.

Complementary monitoring approaches

A large number of Māori organisations, local government and other agencies are interested in using a range of complementary assessment and monitoring approaches (Table 2) for both cultural and environmental monitoring and reporting. To provide quality information to detect change, evaluate progress towards environmental, social, and community goals, and to help with management and decision-making.

Table 2. Complementary assessment/monitoring approaches (adapted from Harmsworth 2002b)

Māori knowledge or culturally based	Community – scientific based	Professionally based – including scientific or technical assessments
Cultural impact assessment (CIA)	SHMAK	River and stream water quality monitoring methods
Iwi monitoring of cultural-heritage sites	Waterway Self Assessment Form Community based	Coastal survey and monitoring Archaeological survey

<p>Iwi monitoring of contaminated sites Cultural health Index Māori wetland indicators Culturally based environmental indicators</p> <p>Requires in-depth Māori knowledge and understanding of particular environments and issues Understanding of Māori values, goals, and aspirations.</p> <p>New Māori knowledge is often created</p> <p>Examples:</p> <ul style="list-style-type: none"> • Māori indicators, defining values • Cultural sites, mahinga kai, pā, papakainga • Cultural health assessments • Cultural history • Taonga lists • Te Mauri • Knowledge on uses and preparation of taonga • Land management, development issues • Cultural information systems, GIS <p>Could include culturally based assessments for river and stream water quality Coastal survey and monitoring of marine environs.</p>	<p>environmental performance indicators Amateur surveys</p> <p>Requires moderate levels of technical input and skill but scientifically robust and part-value based. Cost effective, relatively simple and short duration</p> <p>Community or local knowledge is generated and utilised</p> <p>Examples:</p> <ul style="list-style-type: none"> • Stream and river condition and health • Community based indicators • Community values • Community coastal surveys • Non-technical assessments • School monitoring programmes 	<p>Scientific environmental indicators Laboratory analysis</p> <p>Requires higher levels of scientific and technical input and skill, robust sampling strategies, analysis and interpretation, expensive. May be time-consuming.</p> <p>Scientific knowledge is created</p> <p>Examples:</p> <ul style="list-style-type: none"> • Chemistry, water quality nutrients • Hydrology • Water table modelling • Botanical mapping, classification of plants • pH • Bacterial counts, pathogens • Giardia • Cryptosporidium • GIS applications • Satellite imagery • Studies of fish, macro-invertebrates, macrophytes. • Archaeological survey
---	--	---

State-of-the-environment reporting

SOE reporting is a requirement for local government under the RMA 1991 and under international commitments as required by the OECD (OECD 1997). The OECD is to review New Zealand’s environmental performance in 2005, following the last review in 1997. The 2005 review will focus on waste management, biodiversity, sustainable development, agriculture and forestry, and international cooperation and commitments.

The OECD is increasingly interested in how a country integrates its environmental policies and performance with economic and social programmes and goals. Information will be aggregated nationally for the review and relies on a large range of regional, district and mesh-block datasets. Final reports will undergo peer review examination.

A limited number of Māori organisations have advanced to developing frameworks and tools to report on the state of the environment (SOE) for specific areas (e.g., rohe) and to monitor and report on environmental and cultural change from a cultural perspective. One of the first examples was the SOE report Te Purongo Maniapoto (Kowhai Consulting Ltd & MfE 2002), and more recently the State of the Takiwa project developed by Te Rūnanga o Ngai Tahu (TRONT) (Mattingley & Pauling 2005). Since 2002 a number of groups (e.g. TROK 2005) are designing monitoring approaches to contribute to SOE reporting alongside that of local government. SOE reports for iwi and hapū rely on collating their own knowledge and accessing quality scientific and technical information about the environment from a number of sources.

Te Purongo Maniapoto provides a snapshot of Ngāti Maniapoto values and natural resource and cultural inventories for its rohe, highlights issues, and provides actions and recommendations. The report states that participation is the key for improvements to the natural and cultural environment. The SOE provides baseline information for environmental monitoring but no formal systematic monitoring programme for iwi or hapū was developed.

The State of the Takiwa (Mattingley & Pauling 2005) describes a culturally based environmental monitoring and reporting system developed by TRONT as part the overall Ki Uta Ki Tai – Mountains to the Sea Natural Resource Management framework, outlined in the tribal vision, Ngai Tahu 2025. The main goal is for Ngai Tahu Whānui to record, assess and report on the cultural health of the natural resources and environment in the Ngai Tahu Takiwa. The approach takes into account Ngai Tahu cultural values, such as mauri and mahinga kai and integrates mātauranga Māori and western science. Major outcomes of the project to date include a sophisticated but easy to use database for recording, storage, and analysis of mātauranga and science information, a statistical function, and a reporting system for environmental and cultural monitoring. Takiwa uses a bi-lingual interface, and site evaluation forms will be used to record and enter data into the database. The project is currently being piloted and when expanded will establish a baseline of the natural environment over the whole Ngai Tahu Takiwa to monitor change, develop policy, and set goals to improve environmental health.

Information systems

Information and integrated knowledge systems provide the basis for environmental monitoring and also the platform for up-skilling and building capacity. Up-skilling in new technology is a major focus for many Māori organisations and an increasing number of groups have established, or are developing, their own information management tools such as spatial information systems and databases e.g., Geographic Information Systems (GIS) (Harmsworth 1995, 1997a,b; Mattingley & Pauling 2005). Many groups have

already used databases and spatial information (e.g. maps) for Treaty claims, iwi and hapū management plans, and to support environmental and cultural planning and policy.

Databases provide a central repository that improves access to other types of information, such as aerial photographs, scientific and technical information (e.g., water quality, sampling sites, resource consents, coastal and marine surveys, statistics, land-use maps), cultural information (e.g., cultural sites, natural resources, taonga, archaeological information), and Māori knowledge (public domain and confidential). They can be used to document natural and cultural resource inventories, define values, highlight and prioritise issues, quantify, describe or make comment on change, and give recommendations, actions, and report on progress towards or away from desired goals. Integrated information systems and systematic environmental and cultural monitoring in time can provide a snapshot or baseline. When monitoring uses key indicators in regular time-frames, analysis and reporting give changes and trends that can be used to determine the effectiveness of policy for stated goals.

Discussion

There are an increasing number of reasons why Māori organisations should monitor their own environments and these can be summarised as three main groups.

- An internal driver – to monitor for themselves – and to manage and protect environments with which they have a relationship, and to safeguard and manage natural resources for future generations as part of their own responsibilities and for community wellbeing. These internal drivers come from internal responsibilities such as whakapapa, kaitiakitanga, tikanga – cultural values, community beliefs (e.g., whānau, papatipu rūnanga, hapū), and from tribal expectations. This type of monitoring may be associated with projects (e.g., restoration, rehabilitation, SOE reports) and measure progress towards desired cultural goals such as enhancement of cultural resources and cultural wellbeing.
- To monitor in response to an issue; this could be more reactionary, to provide meaningful information in response to, for example: contamination, toxic waste, impacts on cultural resources, cultural heritage, water quality, dwindling fish stocks, sewage disposal/outfall, pollution, sustainable management of a species or customary harvest. The reasons for monitoring here are usually to determine or detect change and usually form responsive actions, for example, be alerted to a problem or issue, respond to sudden or deleterious impacts, or detect slow or gradual – sometimes imperceptible – change requiring long-term monitoring strategies. It could also be in response to government regulations or major policy shifts where cultural and scientific information can be used to support a tribal position statement or to develop culturally appropriate management or policy strategies and actions.
- In response to external needs and influences, this could be in relation to legislation (e.g., RMA), the Treaty of Waitangi, best practice, and, for example, in response to central government, local government, or industry initiatives.

Examples of these requirements come from national legislation such as the RMA – especially section 35 (i.e. monitoring), industry initiatives and standards such as the Forest Stewardship Council (FSC) (FSC 2001), and initiatives such as the national EPI programme and international drivers such as international agreements, conventions, OECD frameworks and requirements (OECD 1993, 1997).

Future directions

Māori organisations, such as iwi and hapū kaitiaki, deal increasingly with complex issues about which they must make decisions. They are frequently consulted by a multiplicity of stakeholders, including community groups, industry, and local government. They wish to play a more active and equitable role in the sustainable management of resources, in planning and policy, and in environmental monitoring and reporting. To do this they need capacity to engage, and to develop efficient systems and processes to enable them to network and collaborate with a wide range of agencies and stakeholders. They also need access to quality technical and scientific information in a form they can readily use for planning and policy.

Although there are inequitable resource issues, it is highly likely we will see a continuation of Māori groups developing professional capacity, spatial information systems and collaborative projects that contribute to sustainable development and management of New Zealand's natural resources and ecosystems. Most groups want to carry out monitoring and reporting as part of their own functions and responsibilities, but also want contribute to mainstream regional and national programmes. Monitoring and reporting on the physical environment is greatly enhanced when the monitoring comes from cultural, environmental, and value-based perspectives and provides a wealth of information to support effective consultation, collaboration, planning, policy, and project work. There will be an increasing need to use complementary approaches to regularly detect change and report on environmental, social, economic and cultural outcomes and implement appropriate forms of management, policy and projects in response to community and societal goals.

Conclusions

Ecosystems, ecological habitats, and indigenous biodiversity and species in New Zealand are under enormous threat and change (Morgan-Williams & Mulcock 1996; MfE 1997a). While there is increasing concern, considerable effort is also being made to manage and protect New Zealand's natural environment responsibly. Monitoring and reporting on the state of the environment and detecting change through time are important components of this responsibility. An essential requirement of monitoring is to have a clear vision, or sense of purpose (OECD 1997; MfE 1998a; Dymond et al. 2001), and as part of a vision we should be able to measure progress towards or away from agreed sets of goals. We should also realise that these goals will emanate from several different sectors of society and as part of a pluralistic society it is important to appreciate different value systems, and world-views. Culturally based monitoring approaches and reporting are part of this pluralism and should therefore be regarded as complementary and enhancing rather than in conflict. Cultural approaches that report on the state of the environment and its

resources consolidate a country's efforts to achieve equitable outcomes for sustainable development by including minority groups such as indigenous populations.

A large number of examples from throughout New Zealand are given in this paper and provide a glimpse of the level of activity demonstrated by indigenous Māori groups up to 2005. Most of the Māori environmental monitoring initiatives post-2000 are independent of any national coordination, are poorly resourced, and continue to be isolated and fragmented. Most activity represents the work of a number of passionate people in communities, Māori organisations, and government institutions over a short period of time from the mid-1990s. A range of Māori and scientifically based approaches for monitoring and reporting have been developed to date, many are complementary. Monitoring provides Māori with tools to articulate perceptions of environmental change, environmental health, and Māori wellbeing. The tools can be used to give a statement about the state of the environment in time through a Māori lens, and provide a vital reservoir of knowledge for all New Zealanders to improve their understanding of New Zealand's unique and fragile cultural and physical environment.

Acknowledgements

This paper was written with support from the FRST programmes: Integrated Catchment Management (ICM): from the Ridge Tops to the Sea (C09X0305) and: Restoring Indigenous Biodiversity in Human Landscapes – Te Whakaora ake i nga Tini a Tane i nga Whenua kua Rawekehia e te Tangata (C09X0205).

Glossary of terms

Atua	God, deity, supernatural being
Hapū	sub-tribe, pregnant
Iwi	Tribe, bones
Kaitiaki	guardians or the agent who practices kaitiakitanga
Kaitiakitanga	exercise guardianship or stewardship of the environment and tikanga
Māori organisation	iwi or hapū authority, kaitiaki group, or other organisation e.g., Inc, trust, marae
Mana, mana whenua	prestige, control, authority over an area
Mātauranga Māori	Māori knowledge
Mauri	life force, life principle, internal element, metaphysical component of all things, animate and inanimate
Noa	free from tapu, ordinary, unrestricted
Papatipu rūnanga	rūnanga based on ancestral links and centred on marae, hapū, districts
Rahui	restrictions, regulation, or temporary sanction
Ritenga	rules, regulations
Rohe	tribal area, boundary
Taiapure	estuarine or coastal fishing areas of special significance to tangata whenua, a customary Māori area management tool

Takiwa	area/region/district
Tangata whenua	people of the land, having an ancestral link and authority to a given area
Tapu	sacred, ritual prohibition, off-limits
Taonga	Something treasured, e.g., treasured flora & fauna species; iconic, highly valued, precious
Tikanga	customary values and practices
Wairua	spiritual dimension, spiritual qualities
Whānau	extended family, relationships
Whakapapa	ancestral lineage, genealogy
Whenua	land, placenta

References

- Black, T. 1994: Lecture on Te Mauri, June 1994, Massey University, Palmerston North.
- Boothroyd, I.; Stark, J. 2000: Use of invertebrates in monitoring. In: Collier KJ, Winterbourn MJ, eds. *New Zealand stream invertebrates: ecology and implications for management*, Hamilton, New Zealand Limnological Society, pp. 344–373.
- Clarkson B.D.; Ward J. 2002: National Phase 2 workshop: Coordinated monitoring of New Zealand wetlands: A Ministry for the Environment SMF Fund Project, 2 and 3 May 2002, at Brentwood Hotel, Kilbirnie, Wellington.
- Clarkson, B.D.; Clarkson, B.R.; Denyer, K.; Gerbeaux, P.; Harmsworth, G.; Johnston, P.N.; Partridge T.R.; Richmond C.; Smith S.; Wilde R.H. 1999: *Monitoring changes in wetland extent: An environmental performance indicator for wetlands*. Project: Coordinated monitoring of New Zealand wetlands, A Ministry for the Environment SMF Funded Project. Final Report, Project Phase One, prepared by Ward, J.C, & Lambie, J.S, Lincoln Environmental, Lincoln University, Canterbury, 37 p.
- Clarkson, B.R.; Sorrell, B.K.; Reeves, P.N.; Champion, P.D.; Partridge, T.R.; Clarkson, B.D. 2002: *Handbook for Monitoring Wetland Condition: Coordinated Monitoring for New Zealand Wetlands*. A Ministry for the Environment Sustainable Management Fund Project, Ministry for the environment, Wellington, 74 p. Available at: <http://www.wetlandtrust.org.nz/>
- Department of Conservation (DOC), 2001: *Te Angiangi Marine Reserve: Biological Monitoring Plan*. Technical Support Series Number 6, East Coast Hawke’s Bay Conservancy, Department of Conservation, Wellington, New Zealand.
- Department of Conservation (DOC), 2003a: *Te Angiangi Marine Reserve. Operational Plan*, East Coast Hawke’s Bay Conservancy Department of Conservation, Wellington, New Zealand. 45 p.

Department of Conservation (DOC), 2003b: Te Tapuwāe o Rongokako Marine Reserve: Operational Plan, East Coast Hawke's Bay Conservancy, Department of Conservation, Wellington, New Zealand. 42 p.

Downs, T.M.; Ward J.; Clarkson, B.D. 2000: National Phase 2 workshop, Coordinated Monitoring of New Zealand Wetlands: A Ministry for the Environment SMF Fund Project, 1 November 2000, at the Centre for Biodiversity and Ecology Research, University of Waikato, Hamilton.

Dymond, J.R.; Begue, A.; Loseen, D. 2001: Monitoring land at regional and national scales and the role of remote sensing, *International Journal of Applied Earth Observation and GeoInformation (JAG)* 3(2), 162–175.

Forest Stewardship Council (FSC), 2001: Forest Stewardship Council: Principles and Criteria, Bristol, United Kingdom. Available at:
<http://www.bristol-city.gov.uk/susdev/timber2.html>

Gardiner, G.; Parata, H. 1998a: Report to the Ministry for the Environment: Coasts and Estuaries, Biodiversity, Fisheries, Climate Change and Ozone, Gardiner and Parata Ltd, Wellington.

Gardiner, G.; Parata, H. 1998b: Supplementary Report on Māori Input into the EPI Programme, Gardiner and Parata Ltd, Wellington.

Harmsworth, G.R. 1995: Māori values for land-use planning. Discussion report, Manaaki Whenua-Landcare Research, Palmerston North (unpublished), 118 p.

Harmsworth, G.R. 1997a: Māori values for land use planning, Broadsheet newsletter of the New Zealand Association of Resource Management, February, 37–52.

Harmsworth, G.R. 1997b: Māori values and GIS: the New Zealand experience, *GIS Asia Pacific: The Geographic Technology Publication of the Asia-Pacific Region*, April, 40–43.

Harmsworth, G.R. 1999: Coordinated Monitoring of New Zealand Wetlands: Building Iwi Partnerships. Landcare Research Contract Report LC 9899/085. April 1999, prepared for UNEP/GRID Christchurch and Ministry for the Environment, Wellington, 50 p.

Harmsworth, G.R. 2001: A collaborative research model for working with iwi: Discussion paper. Landcare Research Contract Report LC 2001/119 for the Foundation for Research, Science and Technology (FRST) (unpublished), 29 p. Available at:
<http://www.landcareresearch.co.nz/research/social/iwimodel.asp>

- Harmsworth, G.R. 1998/2002a: Environmental Performance Indicators: A Proposed Land Indicators Framework for Environment Bay of Plenty. Reprinted. Landcare Research Report LC 9798/107, 63 p. (Reprinted May 2002).
- Harmsworth, G.R. 2002b: Coordinated Monitoring of New Zealand Wetlands: Phase 2, Goal 2: A generic set of mātauranga Māori based indicators for wetland condition and trend. Presentation given at a national workshop to report on Phase 2 results from 2000–2002, 2–3 May 2002, Brentwood Hotel, Wellington.
- Harmsworth, G.R. 2002c: Māori environmental performance indicators for wetland condition and trend. In: Clarkson BD, Ward J, eds. Proceedings of the National Phase 2 Wetlands Workshop, 2–3 May 2002, Brentwood Hotel, Kilbirnie, Wellington. Workshop as part of the Phase 2, 2000–2002 Coordinated Monitoring of New Zealand Wetlands MfE SMF project.
- Harmsworth, G.R. 2002d: Coordinated Monitoring of New Zealand Wetlands, Phase 2, Goal 2: Māori environmental performance indicators for wetland condition and trend. MfE SMF Project – 5105. Landcare Research Contract Report LC 0102/099 for the Ministry for the Environment and Lincoln University (unpublished), 65 p. Available at: <http://www.landcareresearch.co.nz/research/social/māoriindicators.asp>
- Harmsworth, G.R. 2003: Motueka Tangata Whenua Resource Management Group: Research, Issues, Management and Monitoring in Te Tau Ihu. Landcare Research Contract Report 0203/34/016, 87 p.
- Harmsworth, G.R. 2005: Collaborative Research with Māori Groups as Part of the Motueka Integrated Catchment Management (ICM) Programme. Collaborative learning and ICM web sites, Landcare Research. Available at: http://icm.landcareresearch.co.nz/science_themes/human-dimensions/Māori_and_icm_aotearoa.htm
http://www.landcareresearch.co.nz/research/social/indigenous_index.asp
- Harmsworth, G.R.; Barclay-Kerr K.; Reedy T. 2002: Māori sustainable development in the 21st Century: The importance of Māori values, strategic planning, and information systems, He Puna Kōrero: Journal of Māori and Pacific Development 3, 40–68.
- Hauraki Māori Trust Board (HMTB), 1999: Hauraki Customary Indicators Report. Prepared for the Environmental Performance Indicators Programme of the Ministry for the Environment. Technical Paper No. 57, Māori Indicators Case Study, 117 p.
- Innes, J.; Nugent, G.; Prime, K.; Spurr, E.B. 2004: Responses of kukupa (*Hemiphaga novaeseelandiae*) and other birds to mammal pest control at Motatau, Northland, New Zealand Journal of Ecology 28(1), 73–81.

- Kawakawa Charitable Trust, 2001: Ta Tangarau Catchment Concept Plan. Social, cultural, and environmental goals for the catchment. Pukekohe.
- Kowhai Consulting Ltd. & MfE, 2002: Te Purongo. Maniapoto State of the Environment Report: A Tribal Perspective. Kowhai Consulting Ltd. Te Anga Rd. Rd 8, Te Kuiti, Wellington, Ministry for the Environment, 54 p.
- Lucas Associates, 2001: Jericho Restoration Plan: A plan to restore the mahika kai values of the Jericho Block of the Takitimu Mountains and Waiau valley of Murihiku, Southland. A report prepared for Te Waiau Mahika Kai Trust.
- Mattingley, B.; Pauling, C. 2005: State of the Takiwā: Cultural Monitoring and Reporting on the Health of our Environment – Development of the Takiwā Database, Te Rūnanga O Ngāi Tahu, Christchurch.
- Ministry for the Environment (MfE), 1997a: The State of New Zealand's Environment, 1997, Ministry for the Environment, Wellington.
- Ministry for the Environment (MfE), 1997b: Environmental Indicators: Proposals for Air, Fresh Water and Land, Ministry for the Environment, Wellington, 158 p (+appendices).
- Ministry for the Environment (MfE), (1998a). Environmental Performance Indicators: Proposals for terrestrial and freshwater biodiversity, Ministry for the Environment Wellington, 126 p.
- Ministry for the Environment (MfE), 1998b: Māori Environmental Monitoring: Prepared for the Ministry for the Environment by a panel of independent Māori. Written by Te Ahukaramu Charles Royal. Technical paper No. 26 – Māori, July 1998. Part of a series of environmental performance indicators reports, 70 p.
- Ministry for the Environment (MfE), 1999a: Environmental Performance Indicators: Māori Input into the Environmental Performance Indicators Programme, April 1999. Prepared by the Ministry for the Environment, Wellington, 48 p.
- Ministry for the Environment (MfE), 1999b: The Use of Macroinvertebrates in Water Management. Recommendations of the New Zealand Macroinvertebrate Working Group, Ministry for the Environment, Wellington.
- Ministry for the Environment (MfE), 2002: Case Studies for Māori. The Indicator: News from the Environmental Reporting Team, Ministry for the Environment Wellington.

- Ministry for the Environment (MfE), 2003: Kaimoana Survey Guidelines for Hapū and Iwi. Otaraua hapū in partnership with Shell Petroleum Mining Ltd, New Zealand Ministry for the Environment, Wellington. 75 p + CD.
- Mitchell, C.P.; Davis-Te Maire, K.T.A. 1993: Mahinga Kai Survey of the Upper Waitaki. Report prepared for Ngai Tahu and ECNZ, 26 p.
- Moller, H.; Berkes, F.; Lyver, P.O.; Kislalioglu, M. 2004: Combining science and traditional ecological knowledge: Monitoring populations for co-management, *Ecology and Society* 9 (23), 2.
- Morgan-Williams, J.; Mulcock, C.M. 1996: National environmental indicators: building a framework for a core set—Land: Review of international literature, draft framework and indicators, Agriculture New Zealand, Christchurch.
- Nelson Iwi Resource Management Advisory Komiti (NIRMAK), 2004: Tangata whenua ki Whakatu Environmental Indicator Hui, Tuesday 5 October 2004, Wakatu Inc., Board Room, Nelson, 23 p.
- NIWA, 1998: Stream Health Monitoring and Assessment Kit (SHMAK), National Water and Atmospheric Research, Wellington. Available at: <http://www.niwa.cri.nz>.
- OECD, 1993: OECD Core Set of Indicators for Environmental Performance Reviews, Environment Monograph No. 83, OECD, Paris.
- OECD, 1997: OECD Environmental Performance Reviews: A Practical Introduction, Environment Monograph GD (97) 35, OECD, Paris.
- Polglase, M.; Death, R. 1998: Waterway Self-assessment Form, Institute of Natural Resources, Ecology Department, Massey University, Palmerston North,.
- Stephens, P.R.; Harmsworth, G.R.; Dymond, J. 1999a: Developing Environmental Performance Indicators for Hill Country Erosion. Part 1: Regional Council Approaches, Landcare Research contract report LC 9899/052, prepared for Ministry for the Environment, 41 p.
- Stephens, P.R.; Harmsworth, G.R.; Dymond, J. 1999b: Developing Environmental Performance Indicators for Hill Country Erosion. Part 3: Proposed indicators for erosion-prone hill country in New Zealand, Landcare Research contract report LC 9899/54. Final report prepared for Ministry for the Environment, 45 p.
- Strickland, R.R. 1990: Nga Tini a Tangaroa: a Māori–English, English–Māori Dictionary of Fish Names, New Zealand Fisheries, Occasional Publication No.5. Ministry of Agriculture and Fisheries, Wellington, New Zealand. 64 p.

- Tau, T.M.; Goodall, A.; Palmer, D.; Tau, R. 1990: Te Whakatau Kaupapa: Ngai Tahu Resource Management Strategy for the Canterbury Region, Aoraki Press, Christchurch.
- Te Puni Kokiri (TPK), 1993: Mauriora Ki Te Ao: An Introduction to Environmental and Resource Planning, Te Puni Kokiri, Ministry of Māori Development, Wellington, 35 p.
- Te Rūnanga o Ngai Tahu (TRONT), 1998: Taonga lists: Ngai Tahu Claims Settlement. Schedule 97. Te Rūnanga o Ngai Tahu, Christchurch, New Zealand.
- Te Rūnanga o Ngai Tahu (TRONT), 2005: Cultural Impact Assessments CIAs: Resource Consents: Draft Fact Sheet and CIA TOR. Te Rūnanga o Ngai Tahu, Christchurch, New Zealand. Available at: <http://www.ngaitahu.iwi.nz/Development/Natural%20Environment/Natural%20Resource%20Management/Resource%20Consents/Cultural%20Impact%20Assessments%20%20CIAs...>
- Te Rūnanga o Kaikoura (TROK), 2005: Te Poha o Tohu Raumati: Te Rūnanga o Kaikoura Natural Resource Management Plan, Te Rūnanga o Kaikoura, Takahanga Marae, Kaikoura, New Zealand.
- Te Wananga o Raukawa (TWOR), 1998: Kaitiakitanga: Tona Oranga I Te Rautau Hou: Setting the Agenda for the 21st century, A Māori forum hui, 28–30 October 1998, Otaki, Te Wananga O Raukawa, Workshop Proceedings, Research Report No.E–003.
- Tipa, G. 1999: Taieri River Case Study. Prepared for the Environmental Performance Indicators programme of the Ministry for the Environment. Māori Indicators Case Study, Technical Paper No. 58. 75 p + maps and appendices. Ministry for the Environment, Wellington.
- Tipa, G. 2002: Cultural Health Index. Unpublished notes.
- Tipa, G.; Teirney, L. 2002: Mauri and Mahinga kai Indicators Project: Developing the Cultural Health Index. Unpublished report. Tipa & Associates, Dunedin.
- Tipa, G.; Teirney, L. 2003: A Cultural Health Index for Streams and Waterways: Indicators for Recognising and Expressing Māori Values, Ministry for the Environment, Wellington, 72 p.
- Tipa & Associates, 2004: Cultural Impact assessment for Enhancement of Waipori Power Scheme, Dunedin, prepared for Kai Tahu Ki Otago (KTKO) Ltd.
- Tipa, G.; Crengle, H.; Davis, K.; Allingham, B.; Symon, A. 2002: Cultural Impact Assessment: Project Aqua, prepared by Te Rūnanga O Arowhenua, Te Rūnanga o

- Waihao, Te Rūnanga o Moeraki, Office of Te Rūnanga o Ngai Tahu, Tipa & Associates, Dunedin.
- Tuanuku Consultants, 1998: Tohu Waotu: Māori Environmental Performance Indicators, prepared by the Tuanuku consultants for the Ministry for the Environment, Māori Advisory Group.
- UNEP/GRID, 1999: Coordinated Monitoring of New Zealand Wetlands, Phase 1: A Ministry for the Environment SMF Funded project. Monitoring changes in wetland extent: An Environmental Performance Indicator for Wetlands, Final report, United Nations Environment Programme, Global Resource Information Database, Christchurch. 37 p.
- Waitangi Tribunal, 1991: Ngai Tahu Claim Wai 27: The Ngai Tahu Report, Waitangi Tribunal, Department of Justice, Wellington.
- Walker, D.; Bunt, W.; Stephens, M. 2003: A Cultural Impact Assessment of the Nelson Sewerage Ponds Scheme and Ponds: An Assessment of Effects on the Values of the Tangata Whenua and Recommendations for Change, unpublished report prepared for Ngāti Koata, Ngāti Kuia, Ngāti Rarua, Ngāti Tama, Te Rūnanga o Toa Rangātira and Te Atiawa. Nelson.
- Walker, D.; Bunt, W.; Stephens, M.; Henry, H. 2004: A Cultural Impact Assessment of the Discharge of TBT into the Waimea Estuary: An Assessment of Effects on the Values of Tangata Whenua and Recommendations for Change, unpublished report for Ngāti Koata, Ngāti Kuia, Ngāti Rarua, Ngāti Tama, Te Rūnanga o Toa Rangātira and Te Atiawa. Nelson.