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Title: Coastal Restoration Research that Considers Socio-Cultural, Ecological and Economic Resilience of Local Communities with varying Value Systems: Insights from New Zealand

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Abstract:

Coastal environments provide critical ecosystem services that humans rely on for their survival, and they are often also the focus for people's pride in place and for the identity of an area. Increasingly, however, many coastal environments are being intensely modified and degraded as a result of urban growth and associated port activity and marina development, coastal tourism, flood control, invasive species, industrial development and, importantly in the New Zealand context, from the indirect and cumulative effects of agricultural and horticultural intensification and rural land-use.

The ecological impacts from these accelerating pressures on coastal ecosystems are of serious concern. The degradation of coastal resources in turn negatively impacts on local communities, including indigenous peoples, who are increasingly unable to access coastal ecosystem services, such as food, that they have long relied upon for cultural traditions, sustenance, and recreation. Some coastal ecosystems in New Zealand have been so modified and degraded over a period of decades, that local communities have effectively become 'disconnected' from them.

It has been suggested that for indigenous people, ecological sustainability cannot be separated from cultural survival. New Zealand's indigenous Māori people have been concerned for some time about the degradation of coastal resources, the loss of seafood (kaimoana) or the increasing toxicity of remaining marine species, sedimentation, pollution, eutrophication of waterways, and the associated negative impact that such issues have on their cultural identity and sense of pride (mana).

Successful coastal ecosystem restoration reconnects coastal ecosystems so that they are able to function effectively again, and continue to provide the ecosystem services that humans are so reliant upon. The process of ecological restoration can also help to restore the sense of pride and connection that local communities have with their natural environments and waterways, especially where stakeholders are engaged in processes of restoration.

Accordingly, an integrative, dynamic, collaborative, cross-cultural research project is underway in New Zealand, Manaaki Taha Moana (MTM), to restore coastal ecosystems and their services that are important to local Māori. The central research question is: how can we best enhance and restore the value and resilience of coastal ecosystems and their services so that this makes a positive contribution to iwi identity, survival and welfare in the case study regions?

This paper critically evaluates innovative participatory action research methods that were utilised in the first phase MTM. These methods facilitated ‘end user’ involvement and active engagement of local communities in our research, and were a way of encouraging social learning and understanding of complex sustainability problems. This approach has enabled Māori and non-Māori, public and professionals, ‘conservationists’ and ‘business representatives’ to spend time sharing stories, local wisdom, hopes, and fears regarding the use and importance of coastal ecosystems in a personally-engaged manner. Given the varying perspectives and value systems of different community groups regarding the use and value of coastal ecosystems, such inclusive participatory methods have proven very effective in building awareness the socio-cultural, economic and ecological impact of various coastal resources uses on different user groups. Recommendations are suggested for future coastal research that can empower local communities to positively engage in coastal restoration and sustainable resource management, while at the same time building social and cultural resilience.

1. Introduction

1.1 Importance of Coastal Ecosystems and their Services

Coastal environments provide critical ecosystem services that humans rely on for their survival (Wilson & Liu 2008) and can be a focus for people’s pride of place and for the identity of an area (Panelli et al. 2008; Pedroli 2005; Sunde 2008). ‘Ecosystem services’ are those things that the natural environment contributes to humans for our very survival and wellbeing. Ecosystem services include *products* like clean drinking water or wood products, and *processes* such as the filtering of waste, protection from floods, spiritual and recreational benefits. Academia typically groups ecosystem services into four categories:

- *provisioning*, such as the production of food and water;
- *regulating*, such as the control of climate and disease;
- *supporting*, such as nutrient cycles and crop pollination; and
- *cultural*, such as spiritual and recreational benefits.

However, many ecosystem services are effectively ‘invisible’, and this makes them more likely to be taken for granted, ignored, or not known about at all by some people. This lack of understanding about ‘ecosystem services’ is quite widespread, including by people who have responsibility to make decisions about those very natural environments that provide such important ecosystem services (Hardy et al. 2011).

1.2 Degradation of Coastal Ecosystems

Increasingly many coastal environments are being intensely modified and degraded as a result of urban growth and associated port activity and marina development, coastal tourism, flood control, invasive species, industrial development and, importantly in the New Zealand context, from the indirect and cumulative effects of agricultural and horticultural

intensification and rural land-use (Briefing paper to Incoming Government 2008; Green & Clarkson 2006; Patterson & Hardy 2008).

When measured in economic terms, the magnitude of this loss of coastal ecosystems is very clear. Estuarine ecosystems in New Zealand were broadly estimated to have a value of \$₁₉₉₄ 3,927 million (per year) in terms of the ecosystem services that they deliver, and mangrove ecosystems were estimated at a comparable value of \$₁₉₉₄ 67 million (Patterson & Cole 1999). The entire coastal zone may, in economic terms, provide ecosystem services much more than this, perhaps up to half the value of terrestrial ecosystem services (Patterson & Cole 1999).

The ecological impacts from these accelerating pressures on coastal ecosystems are of serious concern. When coastal areas are modified to make way for urban development, as one example of coastal degradation, this has a flow on impact on the plant and animal life that depend on that environment. For example, removing mangroves destroys the habitat that birds had used to nest their young; the draining of wetlands reduces the capacity for flood protection and filtering of waste that the wetland area once provided (Hardy et al. 2011).

1.3 Connection between Ecological and Socio-Cultural Wellbeing, Particularly for Indigenous People

The ecological impacts from these accelerating pressures on coastal ecosystems are also of serious social and cultural concern. The degradation of coastal resources negatively impacts on local communities, often felt intensely by indigenous peoples, who are increasingly unable to access coastal ecosystem services such as food that they have long relied upon for cultural traditions, sustenance, and recreation (Hardy et al. 2011). New Zealand's indigenous Māori people have been concerned for some time about the degradation of coastal resources, the loss of seafood (kaimoana) or the increasing toxicity of remaining marine species, sedimentation, pollution, eutrophication of waterways, and the associated negative impact that such issues have on their cultural identity and sense of pride (mana).

Things such as the provision of food, the culturally-relevant traditions associated with collecting kaimoana, and the spiritual benefits associated with a healthy coastal environment can also be thought of 'ecosystem services' that are provided by coastal ecosystems. The customary collection of shellfish and other kaimoana from along the coast by tangata whenua for many generations is an important contributor to physical sustenance and wellbeing, but also cultural identity. Māori tribal identity and well-being are inextricably intertwined with place – the features and forms of the land that families and tribal groups are associated with, the natural resources and species of that land and its waterways, the cultural structures like communal centres, and all the histories and knowledge that are part of a place (Smith et al. 2011).

It has been suggested that for indigenous people, ecological sustainability cannot be separated from cultural survival (Smith 2007; also discussed further in Section 3). Some coastal ecosystems in New Zealand have been so modified and degraded over a period of decades, that local communities have effectively become 'disconnected' from them. When coastal environments are polluted, modified or destroyed, the ability for tangata whenua to interact with the coastal environment is also reduced, and thus the inherent connection between 'people' and 'place' is 'disconnected'. Mana (sense of pride) suffers when Māori are unable to demonstrate appropriate hospitality through the provision of kaimoana from their coastal area because of depleted or polluted fish stocks (e.g., see Hauraki Trust Māori Board

2003; van den Belt et al. in review). Māori are thus keen to stem the decline in availability of culturally-important seafood species, for example, and to effect change in the use and management of coastal resources to enhance the sustainability of coastal ecosystems, and in so doing to also enhance cultural sustainability (MfE 2005).

As with coastal estuaries, whereas the river would once have been the social and economic focus of an area, and communities would have accustomed themselves to its vagaries, in many urbanised areas it has now virtually been forgotten (Selman et al. 2010). This displacement of local people from close associations they once had with their coastal environments is further exacerbated by the ‘disconnection’ many experience when excluded from decision-making processes through which ongoing degradation might be stemmed.

Successful coastal ecosystem restoration, such as that intended in the MTM research programme described in the next section, ‘reconnects’ coastal ecosystems so that they are able to function effectively again, and continue to provide the ecosystem services that humans are so reliant upon. The process of ecological restoration can also help to restore the sense of pride and connection that local communities have with their natural environments and waterways, especially where stakeholders are engaged in processes of rehabilitation and restoration. In so doing, the people are also ‘reconnected’ to ‘place’ (Hardy et al. 2011).

1.4 Successful Environmental Restoration Research: a Focus on Research with Māori in New Zealand

Without an understanding of how changes to one part of the coastal environment will impact on the rest of the things in that system, decisions are often made in isolation that end up being harmful to the overall ‘system’ of the coastal environment. The result is that, increasingly in many coastal environments, ecosystems are being intensely modified and degraded as a result of urban growth and coastal tourism, flood control, agricultural and horticultural intensification, invasive species, and industrial development (Patterson & Hardy 2008). Understanding and then bolstering the health of coastal ecosystems and their services requires research that goes beyond the ‘business-as-usual’ single-discipline, single-culture, single-organisation and reductionist approach to science. Fundamental to effective restoration of complex coastal and marine systems is research that is integrative, holistic, dynamic and incorporates cross-cultural dimensions in examination of the system.

It is critical that indigenous knowledge systems are incorporated in research and policy efforts to monitor and restore degraded coastal ecosystems. Indigenous knowledge must be elevated into ‘mainstream’ environmental research, so that it can meaningfully contribute to exploration of the issues facing the world today (Hardy & Patterson 2011). According to Jollands and Harmsworth (2006), however, “the present level of engagement of indigenous groups and communities in New Zealand in sustainability monitoring remains low, under-resourced, and uncoordinated. To improve the worldwide quality of sustainability indicators there is an urgent need to address this poor participation” (p.716). Citing examples of indigenous peoples having had their integrated and holistic development models largely overlooked by mainstream efforts to conceptualise and operationalise sustainable development, Loomis (2000) concludes that “more attention must be paid to indigenous initiatives if we are serious about finding viable approaches to sustainable development” (p. 893). Indigenous people’s philosophical thought should not be dismissed as “having too little analytical or scientific merit in confronting issues such as sustainable development”, or ignored because many groups see them as “obstructionist or idealistic” (p.896). Instead of trying to ‘harness’ practical indigenous knowledge to facilitate preconceived development

models – an approach that is both derogatory and ineffective – there is growing recognition that indigenous epistemologies, science and ethics have much to offer the sustainability debate (Pieterse 1999 on the value of “critical holism”, cited in Loomis 2000, p.896).

Thus, government funding was successfully gained from the New Zealand Ministry for Science and Innovation (formerly the Foundation for Research Science and Technology) for a 6-year environmental restoration research programme, ‘Manaaki Taha Moana: Enhancing Coastal Ecosystems of Importance to iwi and hapū’¹ (MTM), which runs from 2009-2015. The MTM research aims to be ‘integrated’ in its approach to coastal research, by considering the interactions between different aspects of the overall coastal environment. This includes consideration of cultural, social and economic factors associated with the ‘ecology’ of the coastal environment.

Participatory action research methods help accomplish research of this nature, especially in a cross-cultural context involving indigenous people, and in this case local tangata whenua for each case study region (Hardy et al. 2011). The participatory approach of MTM goes some way to facilitating the ‘reconnection’ of links between local communities and their coastal environments, through engagement in the research process itself, with researchers/scientists and local people working alongside each other in the research, and through our collective dialogue and actions to restore coastal ecosystems. Likewise, engagement of local communities in decision making around the selection of detailed case studies for research, and in coastal management policies, is encouraged through MTM. The MTM research approach has enabled Māori and non-Māori, public and professionals, academic researchers/scientists and local people with extensive local knowledge, to spend time sharing stories, local wisdom, hopes, and fears in a personally engaged manner.

The next section of this paper provides an overview of the cross-cultural collaborative MTM research programme and the predominantly participatory action research methodologies utilised in the first phase of that research (for more detail, see Hardy et al. 2011). Section 3 presents perspectives and models about sustainable wellbeing that may be appropriate for environmental research with Māori perspective, which were identified from a review of the literature, and discusses how these models provide insight for MTM research. The paper concludes with suggestions for future coastal research that can empower local communities to positively engage in coastal restoration and sustainable resource management, while at the same time building social and cultural resilience.

2. Overview of MTM

An integrative, dynamic, collaborative, cross-cultural research project is underway in New Zealand, Manaaki Taha Moana: Restoring Coastal Ecosystems of Importance to Iwi (MTM). This section provides an overview of the central research question and objectives of MTM, and the research that was conducted during the first Phase of the study.

2.1 Central Research Question

The central research question is: “how can we best enhance and restore the value and resilience of coastal ecosystems and their services, so that this makes a positive contribution to iwi identity, survival and welfare in the case study regions?”

¹ Iwi = tribe; hapū = subtribe.

coastal ecosystems in their rohe. Both Tauranga Moana iwi and Ngāti Raukawa have catalogued the poor state of many coastal ecosystems in their rohe, recalling accounts from tribal elders, for example, of the abundant kaimoana found 30 to 40 years ago, but no longer today. Both iwi groups are committed to arresting these trends and are keen, through this research programme, to put in place Action Plans and other mechanisms to improve the quality of the coastal environment.

2.2 Objectives of MTM

To achieve the MTM research aim, the research was broken down into three smaller objectives, listed below. Figure 2 broadly portrays the various objectives and phases of MTM.

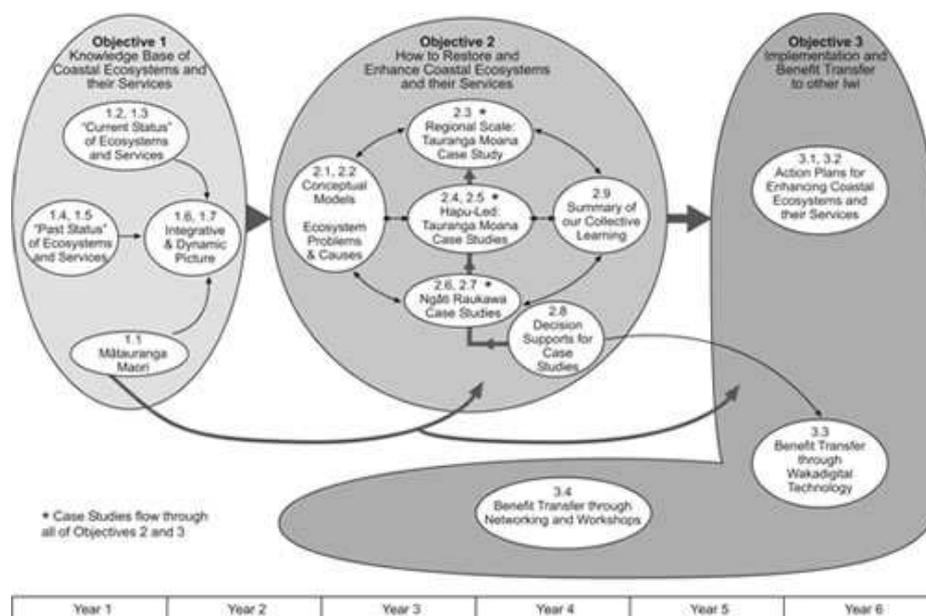


Figure 2: MTM Project Timeline

* *Objective One: Develop a Knowledge Base of Coastal Ecosystems and their Services in the two Case Study Regions.*

This objective focused on determining the extent of critical coastal ecosystems and their services in both of our case study regions (Tauranga Moana and the Horowhenua coast). The relevant research questions were: What are they? Where do they occur? How can they be measured in biophysical, cultural and other terms? How culturally significant are they? How much are they worth or valued?

* *Objective Two: Determine how to Enhance and Restore Specified Coastal Ecosystems and their Services in the two Case Study Regions.*

The MTM team will harness and build on the knowledge from Objective One to answer the central research question of: ‘how can we best enhance and restore the value and resilience of coastal ecosystems and their services, so that this makes a positive contribution to iwi identity, survival and welfare in the case study regions?’

This will be achieved through detailed case studies in both case study regions (Tauranga harbour, and the Horowhenua coast), on topics of importance to local iwi and hapū in ascertaining how to go about restoring coastal ecosystems and their services. The MTM team

will also work in with other ‘end user’ groups and local councils who may also be undertaking complementary-focussed research.

**Objective Three: Implementation and Benefit Transfer to other Iwi.*

The transfer of knowledge and tools developed in the programme will be facilitated through hui, workshops, and networking with national groups, to maximise the benefit beyond the case study regions.

2.3 MTM Research Approach to Restore Coastal Ecosystems and Build Cultural and Social Resilience

MTM takes a holistic approach and considers the social, cultural, economic and ecological factors associated with ‘coastal health’. This integrated approach is complementary to the holistic way that indigenous Māori people approach consideration of interactions with the environment, and thus frames our approach to the research. The holistic, systems view of many indigenous groups actually reinforces the point that ‘ecological’ understandings – like ‘spiritual’ and ‘social’ and ‘economic’ and other subsets of understanding – need to be considered within the wider ‘systems’ view (Hardy et al. 2011). A systems view takes into consideration the interactions between all aspects of the ‘system’, instead of a reductionist, compartmentalised approach as can be the case in western paradigms (Hardy & Patterson 2011). Mātauranga is an all embracing concept combining knowledge, identity, place and in the case of its application to mahinga kai² in the past, the key to bioeconomic security of Māori (Moller et al. 2009).

In MTM, iwi and hapū are engaged in research that aims to restore cultural, spiritual and interpersonal health and functioning for targeted fragmented ecosystems in the case study; the research activities also advance local peoples reconnecting with natural and cultural landscape (Hardy et al. 2011). The concerted efforts thus far have brought people together in one accord to take on the challenges of environmental decline. When kaitiaki³ mobilise together to instigate positive change for coastal and cultural landscapes, they increase understanding that contemporary human relationships with the environment are a highly complex and diverse phenomenon (ibid). Re-enhanced iwi and hapū interaction within a wide range of social, cultural, economic, political and ecological variables (Oviedo et al. 1997) have made a difference in protecting their cultural landscapes.

Central to MTM is an exploration of both western science and kaupapa Māori approaches to defining and valuing coastal ecosystem services of importance to iwi and hapū, and for facilitating the appropriate uptake and communication of such knowledge so that it is ‘heard’ in decision making processes. This requires MTM to identify those coastal ecosystem services that are important to iwi and hapū and to explore ways of ‘measuring’ them alongside the traditional ‘western science’ indicators of ecological health; and to conduct research in such a way that tangata whenua can reunite with their natural and coastal environments. Through this research, it is hoped that hapū and individuals, as well as non-Māori stakeholders/end-users, will positively engage in the search for answers as to why coastal degradation is occurring, and thus in working on practical restoration initiatives to stem that degradation.

² Traditional food gathering from the earth.

³ Kaitiaki = guardian, caretaker, person with responsibility to care for an area (see also Hardy & Patterson 2012).

MTM is developing tools and systems to empower tangata whenua to engage more fully in decision making, management and restoration of coastal ecosystems. Māori and Pākehā involved in this research are passionate and committed to utilising and building upon mātauranga Māori and western ecological science in a mutually mana-enhancing respectful manner. This research approach also utilised during Phase 1 of MTM, particularly by Smith et al. (2011) in the Horowhenua case study and also in Phase 2 in the Tauranga moana case study. Such methodological considerations aim to achieve ecological and cultural restoration goals in a whole-of-person, whole-of-system context. The use of these methods suggest that restoration of fragmented ecological systems is interdependently related to the healing of coastal communities, by reconnecting them with their fresh waterways and resources into the marine, within their natural and cultural landscapes (Smith 2007).

“Despite modification and damage exacted over time, what emerges from action research grounded in a kaupapa and tikanga Māori epistemology of knowledge development is that the restoration of these fragmented ecological systems in a cultural landscape of narratives and significance, is interdependently related to the healing of a community. When local kaitiaki emphasised protective mechanisms based on former customary information and experience about cultural and spiritual areas in landscape at the coast, they forged necessary safeguards to protect against inappropriate use and development. Furthermore, these kaumātua accounts relayed a range of experiences with natural resources and the river and beach environs” (Smith et al. 2011, p. 14).

For a full description of MTM Phase One, please refer to Hardy et al. (2011). Another paper presented to this 2012 ISEE conference (Hardy 2012) also discusses the participatory approaches employed in Phase 1 of MTM, with reference to the sustainability science and integration science literature. In summary, the first phase of MTM was a ‘stocktake’ of existing knowledge about the state of the coastal environment in both case study regions, resulting in two peer-reviewed publications: *Health of Te Awanui Tauranga Harbour* (Sinner et al. 2011), and *State of Ecological/Cultural Landscape Decline of the Horowhenua Coastline Between Hokio and Waitohu Streams* (Smith et al. 2011). Additional activities and tools developed included:

- * many hui (meetings) and workshops with local communities;
- * creation of ‘digital libraries to ensure access to information was more accessible for local Māori and other decision makers and coastal resource managers (see: http://www.mtm.ac.nz/client/knowledge_centre-digital_library.php);
- * many hikoī (travelling workshops or walking/talking hui) of the Horowhenua case study rohe (area), which involved the research team walking and camping upon the land alongside tangata whenua and other people from diverse groups from the local community, to share knowledge and build understanding about the degradation of coastal resources, and to prioritise future research needs;
- * mediated modelling workshops with stakeholders from diverse sectors and community groups to help us gain a greater understanding of the key factors that are impacting on the state of the moana (harbour), and to identify the critical “leverage points” that are likely to have the greatest impact to restore things that are currently degraded; and the associated development of a scoping model of the Tauranga harbour (see <http://www.mtm.ac.nz/mediated-modelling/>); and

* collaborative learning and practical landscape design options developed through a collaborative with 4th year Landscape Architecture Design students at Victoria University in Wellington and iwi and hapū of Ngāti Raukawa in the Horowhenua.

Smith et al. (2011) included mātauranga and western science knowledge about the coastline, and described how iwi and hapū have interacted with these valued ecosystems historically. The research investigated intricate and complex environmental problems, assessed the extent of ecological decline in the case study area, and considered how well kaitiaki (as caretakers of the natural environment and their cultural landscapes) are dealing with the impact of fragmented systems with associated effects on their human condition. Various kaitiaki in the Horowhenua to northern Kapiti region engaged in action (i.e., kaupapa Māori research and oral archiving) research to collate knowledge about the decline of species and to devise enhancement activities for ecosystems that are more meaningful and relevant to their local Māori communities (Hardy et al. 2011). They used tikanga-based approaches when exacting research such as karakia (incantation) or mihi (welcoming speeches) to open and close oral archiving sessions (Hardy et al. 2011). They have also grounded the collaboration with other entities through the exercise of tikanga and powhiri protocols at marae within the case study (Smith et al. 2011), particularly before students or research collaborators ventured out into the field for hīkoi, or for noho marae (stay over at marae) at Te Pou o Tanui Marae in March 2011, or presented their projects at Tukorehe Marae (Hardy et al. 2011).

Sinner et al. (2011) also reported on the state of Te Awanui/Tauranga harbour. The report will increase the contribution that MTM can make towards maintaining and enhancing coastal taonga (valued resources) for the iwi and hapū of Tauranga Moana. An additional report summarising the mātauranga Māori and understanding of the health of the moana is also being developed.

2.4 Ongoing Research in Phase 2 of MTM

The stocktake exercises resulted in greater awareness of what was not known about degradation occurring in these coastal environments. In the Horowhenua case study (from Hokio to Waiwiri streams), iwi and hapū have evaluated and defined preferred options with their research collaborators for actively enhancing and restoring coastal and once culturally significant ecosystems in this distinct tribal area. Over time hands-on action research and rehabilitation programmes for valued ecosystems have taken place as kaitiaki respond to the severe environmental decline of ancestral lands and waterways in their areas of kaitiakitanga responsibility (Smith et al. 2011).

2.4.1 Resultant ongoing research in the Horowhenua case study includes:

- **Review of factors influencing the health of Toheroa** (and other shellfish) populations in the coastal zone of Ngāti Raukawa – this review will be conducted in order to design targeted habitat quality investigations to identify sources and how to address them. Toheroa was selected because of its cultural significance as a delicacy species. Considered the ultimate expression of manaakitanga (akin to hospitality and care) to your visitors, it is regarded as kai o te rangatira: the food of chiefs. Like several other shellfish and fish species found in areas of mahinga mataitai (food gathering locations in coastal freshwater, brackish water and coastal foreshore areas) they are endangered species and/or under threat from a range of impacts. This work may be conducted collaboratively with other iwi groups around New Zealand who are also concerned about the decline of this important species (Hardy et al. 2011).

- **Ghost shrimp and surf zone habitat quality** - Ngāti Raukawa and affiliated iwi are concerned at decline of toheroa and other taonga species along their coastline. This study will investigate how habitat previously occupied by culturally significant shellfish species has changed with the expansion of ghost shrimp colonies and look for clues as to whether this expansion might be a cause or effect of shellfish decline. This will involve mapping of 'ghost shrimp' along the rohe, oral interviews with kaitiaki about the abundance of this species over time and its relationship to other shellfish species, and other related Mātauranga, and some core sampling and analysis (Hardy et al. 2011).
- **Water quality** - Using the Waiwiri stream as a current research example, the aim of this case study is to identify sources of poor water quality and to rehabilitate habitat in the Waiwiri stream in areas that are considered to be of high cultural value for seasonal harvest of kai moana (specifically toheroa, tuatua and kahitua), and freshwater species such as tuna (eel) (Hardy et al. 2011).
- **Restoration of coastal freshwater loop system** - The aim of this case study is to restore aquatic ecosystem functions and services in the Ōhau 'loop', a coastal river remnant. This will involve: assessment of aquatic ecosystem functions and their significance to whanau, Hapū and Iwi and, as well as factors impairing these functions; making recommendations regarding the rehabilitation of the loop, including restoring part or all of the flow from the Ōhau River down through the loop, riparian planting, weed removal; and monitoring indicators of ecosystem health (Hardy et al. 2011).
- **Restoration options for coastal wetlands and lakes of cultural significance** - coastal wetlands such as Te Hākari, Pekapeka Taratoa sand blow to wetland, Waikawa, Manga Pirau, Lakes Huritini, Waiorongomai and Kahuwera have been severely degraded in the past 100 years due largely to vegetation clearing and drainage, to make way for pastoral farming, as well as direct effects caused by grazing stock. The Manawatu/Wairarapa region is estimated to have lost 97.4% of its wetlands (since 1900), with just 1% of swamp areas still intact (Smith et al. 2011).
- **GIS and other spatial mapping of cultural landscape and other Information Technology tools** - this includes cumulative mapping, spatial mapping and visualisation of action plans for iwi and hapū. New technology will be tested on a degraded coastal ecosystem in the Horowhenua case study, which will allow visual tracking of the physical state of that ecosystem over time. This involves a video device 'flying' over the landscape capturing images over time, which is a powerful means of visualising the state of an ecosystem, when changes occur, and how quickly. To ensure that the powerful 'story' told by the GIS information collected in the previous "Iwi Ecosystems" research is captured and can be 'told' in a meaningful way, a 'storyboard' will be created of the key features that incorporates images and text/description.
- **Ecological economics analyses** - A particular case study valuation will be undertaken in early 2012 on the trade-offs between dairy farming economic returns and the degradation of ecosystem services from those activities. The interactions between dairy farming and wetland and other aquatic values will be particularly important in this valuation. It is hoped that this analysis will provide a more holistic appreciation of the 'true' value of dairy farming particularly as it impinges on both economic and cultural values that are important to Ngāti Raukawa and associated iwi and hapū of the case study region. It is intended that this ecosystem services valuation work will not only provide iwi and planning authorities with important information on how to sustainably manage coastal land and the Horowhenua coastline, but it will also place some emphasis on developing new methods for valuing ecosystem services apart from the traditional monetary-based neoclassical methods (Hardy et al. 2011).

- **Oral archive of Mātauranga (Māori knowledge)** - a series of interviews will be conducted with tangata whenua to determine the way in which peoples' relationships with coastal rivers, streams and lakes have changed over time. This will create an oral archive of the way that coastal ecosystems played in the lives of iwi, hapū and whanau, and the impact that the degradation of these places has had. Likewise, we aim to ascertain the impact on tangata whenua of efforts to re-engage with these places in an effort to restore them (Hardy et al. 2011).

2.4.2 Resultant ongoing research in the Tauranga case study includes:

- **Broadscale survey of Tauranga harbour, and Species and Community Health Modelling** - to understand the role of various anthropogenic stressors on biodiversity, and to develop species distribution models and community health models for the harbor. This will allow us to map the distribution of key species and environmental variables. Species models can also be used for resource management applications such as predicting future species distribution under varying scenarios such as, for example, increases in sedimentation due to climate change or decreases in nutrient levels due to catchment practices. We will then develop community health models to assess changes in benthic communities along the disturbance gradient of sediments, nutrients and contaminants. This approach assesses the current ecological health of the harbour and can be used for future monitoring to assess whether sites are improving or degrading over time (Hardy et al. 2011).
- **Shellfish health assessment** - to determine the current extent of shellfish beds and identify the factors that affect intertidal, and possibly subtidal, species distribution. This may include investigation of the link between shellfish condition and levels of sedimentation and contaminants within the harbour; assessment of whether existing levels of sedimentation or pollution limit the distribution of shellfish beds; assessment of how the loss of shellfish beds affects the ecological functioning of benthic communities. Core samples are being taken to assess abundance of key shellfish species. This data will be linked in with the Broadscale survey data to generate species response curves to various physical variables (Hardy et al. 2011).
- **Coastal Cultural Health Index (CCHI)** - the aim is to develop a tool that can document the mātauranga Māori of the health of Tauranga harbour, and align this with western science measures of coastal ecosystem health. The method to be utilised for this tool development is still being finalised, but will likely involve adaptation of the 'State of the Takiwa' methodology developed for freshwater ecosystems, which is currently being adapted for estuarine environments in other research by other iwi in New Zealand (Ngai Tahu and Ngāti Kahungunu) with members of our MTM team. We will likely build upon Bishop's (1996) approach, which included whanaungatanga (enduring relationships) to underpin the research and ensure that the CCHI is embedded in the local community; relevant to the community's issues and capabilities; and designed to meet the shared aspirations and expectations of the participating parties. The MTM team will attempt to create a plan where the different monitoring, e.g., Benthic Health Model and CCHI, will be undertaken concurrently to maximise opportunities for capability development and information sharing. We hope to develop a spatially detailed map showing the health of the harbour as assessed by mātauranga Māori, using "traffic lights" to show hot spots of impacts. A database will also be created, that integrates with data from other components of the Tauranga case study, to store data over time. The CCHI is a tool that local iwi and hapū members would be trained to undertake the assessment at regular intervals into the future, thus empowering them to take an active ongoing role in the monitoring of self-determined critical ecosystems (Hardy et al. 2011).

- **Other species-specific case studies** - will likely follow on from the community health modelling work, which will reveal those specific communities that are most threatened.
- **Mapping cumulative human impacts on coastal ecosystems in Tauranga harbour** - adapting the method employed by Halpern et al. (2008, 2009), one potential model that the MTM hopes to develop is a model that maps the cumulative impact of various human activities on coastal ecosystems. This analysis allows us to identify areas where protection and mitigation measures are most needed, through the use of human impact scores.
- As for the Horowhenua case study, we will also undertake spatial mapping and modelling, Information Technology tool development, and Ecological economics analyses for Tauranga moana.

The following section presents models and frameworks from the literature that are relevant to the ongoing MTM research and which may also be applicable to other similar studies. Many of the approaches discussed in Section 3 will help guide the research proposed for MTM Phase 2, as outlined in 2.4.1-2.4.2.

3. Sustainability and Wellbeing – Models and Perspectives Identified in the Literature of relevance to Indigenous Māori Communities

In attempting to conduct collaborative, cross-cultural research with indigenous peoples in a way that appropriately addresses environmental justice, ethics and values, it is necessary to consider various frameworks or models for how such research may have successfully been conducted previously. Likewise, indigenous perspectives of human-nature interactions, and related resilience of both systems, are typically quite different from the way in which ‘western’ scientists and researchers may have been educated and how they perceive the world. Thus, this section explores some models and frameworks of some indigenous peoples, or research frameworks that have been proposed in the international and New Zealand literature, which are relevant to Manaaki Taha Moana. Likewise, the following models and frameworks may also offer insight for other researchers conducting similar research.

3.1 Mind Maps of Māori (Roberts 2010)

Roberts (2010) gives a concise and informative overview of the mental maps constructed by New Zealand Māori by which means they made sense of their phenomenological world.

“Salmond (1982) has discussed in some depth the use in European discourse of ‘landscapes’ as metaphors for knowledge. She comments that in contrast “these metaphors apply literally to the Māori case, where knowledge and power could be “talked into” physical objects ... and fixed there by name”. Moreover, children were taught particular accounts in the place to which that knowledge belonged, so that the past is made present and space–time distances are collapsed. This close relationship between Māori people and the land is emphasized in genealogical (whakapapa) accounts ... and symbolized by the words ‘tangata whenua’ in which ‘tangata’ means people and ‘whenua’ placenta; thus humans are the children of the earth mother Papatuanuku. This observation is true of many other indigenous cultures as explained by Whitt et al. (2001)” (Roberts 2010, p.7).

Roberts explains that for Māori, in contrast to human whakapapa [genealogy], non-human whakapapa may contain a variety of what modern science would classify as living and non-living entities—a distinction which does not apply in the Māori worldview. Their whakapapa

focus on and reflect things of importance such as the cultivated food plants, or stone materials, or any other phenomena necessary for survival.

“In pre-literate societies, mental maps help to locate and fix things of importance to a culture in time and place. The landscape itself is clearly an important referent not only in spatial terms but once named, it also served as a repository of mythical, spiritual and historical information. Once rendered cultural, the landscape acted as a mnemonic whereby knowledge of past events could be remembered and recalled by walking the land and retelling the narratives pertaining to that place. Place names have been variously described as “survey pegs of memory” (Davis et al. 1990) or as ‘word fossils’ of equal value to ethnologists as fossils of past plant and animal life are to palaeontologists (Graham 1881–1885)” (Roberts 2010, p.7).

This account emphasising the importance of place and landscape in social, spiritual and cultural identity is reinforced by other researchers. According to Panelli et al. (2008), both the construction and ongoing use of the marae (cultural centres) illustrate the cultural significance of a local place-based identity. Thus, it is very evident that for environmental restoration research with Māori, the connection of people with land/place is paramount; research must be integrative in that it must not reduce and compartmentalise the different components of the system being studied, but instead must purposively aim to understand the interconnectedness between the socio-cultural and ecological factors within the system being researched.

Basso (1996, p.34) states that “knowledge of places is therefore closely linked to knowledge of the self, to grasping one’s position in the larger scheme of things, including one’s own community, and to securing a confident sense of who one is as a person”. Thus, for Māori, it is clear that ecological and socio-cultural resilience of inextricably linked, a point that is reinforced by Smith (2007), who is the leader of the Horowhenua case study in the MTM research.

The significance of specific locations is evident in Roberts’ account of the mind maps of Māori, and this brings into question the appropriateness of attempting to generalise findings from one case study to other areas in New Zealand or overseas. This presents a potential problem for government-funded research, such as the MTM research, because one outcome by which the research will be evaluated is how meaningful the ‘research results and findings’ are for other areas beyond the case study region, so that the research can be beneficial and have national relevance. While broad understandings and methodologies developed in MTM may be applicable elsewhere, it is clear that specifics need to be tested and evaluated with the local communities to which they will be ‘transferred’, to ensure they ‘fit’ with local conditions.

Panelli et al. (2008) state that the perceptions of place identity held by a resident (or internal) and a visitor (or external) will differ significantly. Thus, great care must be taken in designing and conducting research whereby different knowledge systems are drawn upon, because the inferences and perceptions of understanding of any given phenomena or system will vary according to the worldview of each person. This has huge implications for MTM, and for any environmental restoration research with local communities, and great care must be taken to ensure local and traditional knowledge is not misappropriated or ‘lost in translation’ during the research collection, analysis and dissemination process.

3.2 Developing Cohesion and Building Positive Relationships through Storytelling (Baskerville 2011)

Effective integrative research with Māori to build ecological and socio-cultural resilience requires a long-term focus and commitment. Moller et al. (2009, p. 235) provide an interesting description of the long-term nature of effective cross-cultural, participatory action research:

“The full trust and experience needed for harmonious research process were not fully established until 8–10 years into this project... If it takes nearly a decade to establish the trust and the experience needed to work fully effectively in this cross-cultural arena, there is little prospect that many of New Zealand’s 50+ iwi will have an opportunity to participate in long-term science projects directed at issues of substantive interest to their *whānui* (wider families)...”

MTM aims to develop action-oriented plans to restore coastal ecosystems of importance to local Māori, to help build cultural resilience and identity, and thus much ‘learning’ and capability development needs to occur throughout the research process. This co-learning is between the members of the inter-disciplinary, cross-cultural, cross-organisational research team; and also between the research team itself and the community members and local stakeholder participants who interact with and help conceptualise and complete the research. Baskerville (2011) developed a model for developing cohesion and building positive relationships through storytelling in a culturally diverse New Zealand classroom. In the New Zealand classroom, teachers are being encouraged to adopt and use teaching strategies that are more culturally inclusive, collaborative and allow for reciprocal teaching and learning where student prior knowledge is legitimised (Bishop & Glynn 1999; Bishop et al. 2009). Given the intent of MTM to promote co-learning and genuine knowledge sharing, such frameworks from education disciplines are very relevant. Baskerville’s research revealed four interrelated key factors to developing a culturally inclusive classroom: developing a way of working, establishing a caring supportive learning environment, privileging participant student voice through personal stories, and enhancing participant connectedness and relationship change. Figure 3 below depicts



Figure 3: A culturally inclusive teaching and learning approach to generate enhanced understanding of self, others and cultural perspectives (From Baskerville 2010, p.110).

Storytelling was found to be a powerful way of drawing together the different aspects of this culturally inclusive approach to teaching and learning. Collins (1999) found that adults and

children frequently use storytelling to make sense of their world; storytelling as a teaching strategy helps students engage cognitively by making connections between their prior knowledge and new knowledge. Through the experience of engaging in storytelling, students become more open to taking in and sharing knowledge, and established greater trust in each other. A shift in power relations also occurred whereby the ‘teacher’ also became the ‘learner’, and vice versa. Stories are also catalysts that prompt memories, and help people to forge cognitive connections in their understanding of concepts (Baskerville 2011). Respect for cultural knowledge is pivotal in building trust and emotional connectedness that promotes learning.

Storytelling was one dimension of the mediated modelling workshops that occurred during Phase 1 of MTM (van den Belt et al. in review). This allowed participants to share recollections and stories about how they used to interact with the coastal environments as children when ecosystems were healthy and social structures were also more intact. Likewise, the hikoi along the Horowhenua coast case study area provided opportunity for local tangata whenua to tell stories of importance about the locales, species and connections that the group walked and camped upon. A much greater degree of trust and willingness to listen to and learn from others in the group transpired as a result of both the mediated modelling and the hikoi (see Hardy et al. 2011; Smith et al. 2011). Greater use of storytelling could be utilised in subsequent stages of MTM to facilitate ongoing co-learning within the research team, but also with local community groups who participate in the research.

3.3 Creating Space for Interdisciplinary Marine and Coastal Research (Christie 2011)

As summarised in Table 1 below, Christie (2011) has proposed resolutions for commonly-faced dilemmas faced by interdisciplinary teams conducting research in the marine and coastal area.

Table 1: Criteria for interdisciplinary evaluation of ecosystem based management programmes (From Christie 2011)

<i>Category</i>	<i>Criteria</i>
Process	<ul style="list-style-type: none"> Planning processes and policies consider local context Transparent and participatory decision making processes used for programme planning and evaluation Social and natural science-generated information and local knowledge influence planning The EBM programme area and goals defined to consider ecological scale and interactions, while considering governance feasibility (e.g. management areas represent ecological boundaries while considering institutional jurisdictions and capacities) Planning processes and policies evolve based on monitoring information and experience Education programme developed to raise awareness about ocean conditions, consider tradeoffs, and disseminate lessons among practitioners and appropriate constituencies Sustained commitment to EBM is fostered Planning processes consider trade-offs and establish means to equitably distribute costs and benefits while establishing conflict resolution mechanisms
Output	<ul style="list-style-type: none"> Reference points for resource extraction (e.g. catch-per-unit-effort or biomass) and environmental integrity (e.g. biodiversity, habitat condition) established at a precautionary level A suite of management tools, including but not limited to MPAs, employed to address resource and habitat goals Multi-sectoral planning and implementation organizations, which are responsive to ecological scales, established and supported Formal legal and policy frameworks established to foster EBM Human and institutional capacity increased to respond to demands of EBM

There is much of relevance for MTM, particularly the importance of consideration local context in planning processes and participatory decision-making. Likewise, it is important that knowledge from the social and natural sciences does, and is seen to, influence findings

and outcomes, as well as local knowledge. The fairness and equity of trade-offs is also a fundamental factor in whether or not proposed actions will gain the commitment of stakeholder groups who will need to implement such recommendations in practice; these people will be more inclined to see recommendations through to fruition if they have been involved in the process of developing those recommendations and/or can see evidence of them having been generated from trusted data and experience. The value of education to foster greater understanding amongst the community is also a very important aspect of research, which is often only given minimum attention, if at all. Having evidence-based evaluation tools to ensure actions are bringing out intended outcomes is also imperative, as is having pre-determined indicators are targets to that people know what they are aiming to achieve, and why.

3.4 An Indigenous Perspective on Water Recycling: Mauri Model (Morgan 2006)

Māori people have always valued water as a taonga (treasure); thus water bodies such as rivers, lakes and wetlands have their own mauri (binding force between physical and spiritual) which it is important for tangata whenua to protect from pollution, degradation and damage (Morgan 2006). Rivers, lakes and wetlands are also key elements in identity, whakapapa (genealogy) and mana (authority, status or prestige) of the hapū⁴ (ibid.). The Mauri Model depicted in Figure 4 below was developed by Morgan (2006) in order that indigenous perspectives might be appropriately included in infrastructure evaluation and decision-making. The central concept is mauri to identify tangata whenua perspectives of sustainability when considering various proposed infrastructure developments or techniques. When applied in practice, the model identified significant differences with regards to the conventional and Māori approaches to considering the appropriate use of recycled water, particularly wastewater (Morgan 2006), due to the necessity to maintain the integrity of the mauri of water that regulates how it can be recycled. Recycling some waters in a culturally consistent manner could only be achieved by returning water to the ground or onto land (ibid.).

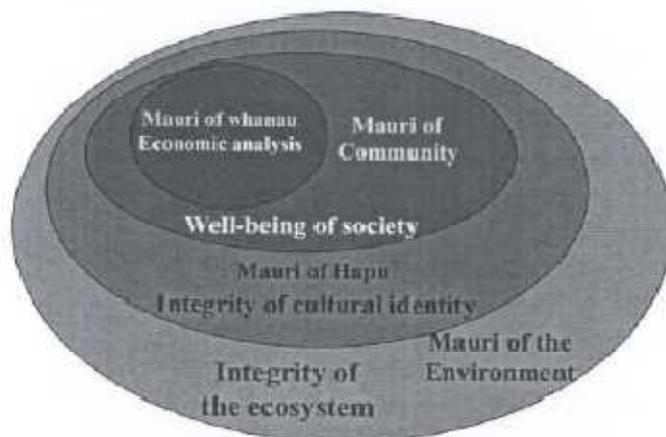


Figure 4: Mauri Model Representation of Four Spheres of inter-relatedness (From Morgan 2006, p.130)

The New Zealand Local Government Act (2002) states that regional and territorial authorities must play a broad role in promoting the social, economic, environmental and cultural wellbeing of their communities, taking a sustainable development approach. The New Zealand Waste Strategy (MfE 2002) states that Māori have a unique perspective and role in

⁴ A hapū is a subtribe or clan group associated with a particular rohe/geographical region (Morgan 2006).

waste minimisation and management; and that decision-making must allow for direct Māori input into policy, standards and guidelines, monitoring and evaluation, and iwi (tribe) consultation in preparing waste minimisation plans. However, the paucity of tools and frameworks to help the predominantly pakeha (non-Māori) decision makers appropriately incorporate Māori values into decision making is an impediment that the Mauri Model was developed to help overcome. “Adoption at the level of local governance has been very difficult and frustrating for both Tangata Whenua and local government leaders and administrators. The problem stems from juxtaposed paradigms of municipal engineering on the one hand and the Tangata Whenua values and beliefs on the other. Whenever water management is considered there is often disagreement” (Morgan 2006, p.129).

The Mauri model depicted in Figure 4 portrays the inter-relatedness of all living things within the ecosystem, based on the whakapapa of creation, as perceived by Māori. It establishes the basis for the holistic view of the environment and our ecosystem held by tangata whenua (Morgan 2006). Economic, social and cultural criteria are all successive subsets of the environment. The criteria are redefined as the impacts on the mauri of the whanau or family, including functional or technical considerations⁵ (economic); the mauri of the community, including health and hygiene considerations (social); the mauri of the hapū (cultural); and the mauri of our ecosystem (environment), respectively (ibid.).

The relative importance of each aspect can be independently weighted and each given a score, based on the tangata whenua understanding of traditional practices and how these relate to our ecosystem. The Tangata Whenua evaluation is based on whether the development option is identified as enhancing, diminishing, or neutral for the mauri⁶ of the aspect being considered.

“The environment is considered the all-encompassing aspect being assessed and is given priority over the other aspects. In particular the environment encompasses culture as demonstrated by the practice of rahui (prohibition). A rahui is placed on an area of resource when its mauri is being jeopardised by overuse of some other significant event. This process prioritises the environment ahead of the other criteria until the mauri of that area or resource has recovered” (ibid., p.131).

The mauri of the environment is measured in the context of both the physical health of the environment and its spiritual integrity, which brings into consideration the geographical boundaries between the rohe (areas) of each hapū, and the impacts of actions in one catchment/rohe on the hapū in another surrounding area, such as estuaries, harbours and oceans. This is of great significance to MTM which is concerned with the restoration of coastal ecosystems, whereby the “wastes” created in catchments end up deposited into coastal estuaries and harbours. Tangata Whenua have stated that water is taonga over which they have kaitiakitanga⁷ and in particular that cross rohe transfer, that is out-of-catchment transfer or disposal of wastewater or stormwater is a serious concern (ibid., p. 131). Further, the condition of the environment is passed on the future generations, which is of most importance to Tangata Whenua.

⁵ Technical applicability is considered to be fundamentally a function of cost.

⁶ “As Mauri is a measure of the life-force in a particular living thing, then how the mauri is affected is a direct indication of the long-term viability and hence the sustainability of a particular options from the Tangata Whenua perspective” (Morgan 2006, p.130).

⁷ Kaitiakitanga is defined by Morgan (2006) as the ethic of guardianship.

“Catchments are natural partitions of the environment typically used by Tangata Whenua to define the rohe of hapū. Thus the hapū is the appropriate traditional level for resource management decision making as the condition of a particular catchment and how it is managed impacts directly on the state of the environment and the standing and authority of the Tangata Whenua. Tangata Whenua have for this reason stated that the mauri of water bodies must be protected” (Morgan 2006, p.131).

Thus, the management and use of water systems in each locale is of major concern to Māori, and it is important that research involving water quality, or the health of other ecosystems that are impacted by or impact on water systems, is done in close collaboration with the specific hapū of that rohe (area). The Mauri Model proposed by Morgan is a significant step in bridging the gap in understanding often felt by pakeha researchers and decision makers in attempting to incorporate such concepts and measures into research and policy.

According to Morgan (2006, p.135), from a “Tangata Whenua perspective, an integrated holistic approach to management of water infrastructure is required that:

- *maintains sufficient water flow to support ecosystems;
- *increase water use efficiency and recycling;
- *decreases wastage of the water resource;
- *reduced, recycles or eliminates wastewater and stormwater flow;
- *encompasses the views of Tangata Whenua;
- *considers the timeframe of “the mokopuna of the mokopuna (grandchildren) or a minimum of 150 years”.

3.5 The Cultural Values Model (Stephenson 2008)

According to Stephenson (2008), cultural identity is strongly associated with the way in which people interact with their landscapes, and landscapes are thus valued in multiple ways by those people who are closely associated with them. Thus, those people responsible for planning and policy related to landscapes (such as coastal resource management and planning, which relates to the MTM programme) need to be aware of the nature and range of cultural values attributed to a landscape. The Cultural Values Model (CVM) depicted in Figure 5 offers an integrated conceptual framework for understanding the potential range of values that might be present within a landscape and the potential dynamics between these values; as well as the contribution that landscapes can make to cultural identity and sustainability (ibid).

In the CVM, Stephenson (2008) clusters culturally valued aspects of landscape into three components: Forms (the physical, tangible and measurable aspects of landscape or space); Relationships (meaning, significance and interpretations of landscape are generated by human relationships with and within landscapes); Practices (includes human and natural processes, past and present actions/traditions/events, which is a continuum of dynamic action). The three categories encompass the range of landscape values expressed by both disciplines and insiders.

is very important. Appreciation of the forms, relationships and practices related to both surface and embedded values will enhance the cultural integrity of proposed action plans and restoration recommendations.

Further the model aids in generating cross-cultural awareness and appreciation, and in considering how the various culturally important aspects of landscape should be incorporated into interdisciplinary or transdisciplinary research designs.

3.6 The Coasts Under Stress Project (CUSP): Canadian interdisciplinary case study methodology (Ommer 2010)

As so eloquently stated by Ommer (2010), interdisciplinary research requires scholars to learn by doing, an approach that also resonates with tangata whenua in New Zealand. A large, integrated, interdisciplinary research team was established in Canada to address complex interdependent social and environmental issues associated with coastal social-ecological stress. It uncovered linkages (‘pathways’) between the main drivers of social-ecological health in both human and environmental communities. Accordingly, this study has the potential to offer insights into the conduct MTM, in helping us to appreciate the dynamics at play in the degradation of coastal socio-ecological environments in New Zealand, and how to go about fixing this problem with tangata whenua. The CUSP programme developed a research methodology whereby team members shared their vision of what they wished to achieve (in the sub-component aspects of the research that they were involved in), and meetings were facilitated in a variety of ways such that cross-fertilization and discussion were ongoing, and team members knew exactly where their work fitted into the greater whole (Ommer 2010, p.478). Similar visions and methodologies are employed in the MTM programme, although greater integration could occur through more deliberate and routinely timetabled hui (meetings) and discussions to purposively ensure that cross-fertilization of ideas occurs between team members.



Figure 7: Social-ecological framework of restructuring and health for situating individual parts of interdisciplinary research. (From Oomer 2010, p.482)

Figure 7 depicts how the CUSP team explored the past, in order to understand the present, in order to plan for the future of coastal systems. This requires input from natural and social scientists with knowledge of institutional, environment, industrial and social domains of ‘health’ and ‘wellbeing’, and the determination of appropriate indicators for each domain (Ommer 2010, p.482). Further, the impact of ‘restructuring’ (or purposeful change) in each domain on social-ecological systems is critical, and thus the interdisciplinary team members must be able to think outside their disciplinary box and communicate effectively with people who use different jargon and perhaps think of the world from a different perspective. All team members needed to understand what was happening in the ‘domains’ outside their area of expertise; e.g., social scientists needed to understand what was happening to the ocean and the fish, and natural scientists needed to understand why people dumped logs on the seabed, created pollution in the coastal zone and kept fishing when stocks were vulnerable (ibid.). “Collaboration was required to approach the real answers” (ibid, p.484). This also requires researchers to be willing to conduct research using different methodologies that they may be most comfortable or have expertise in.

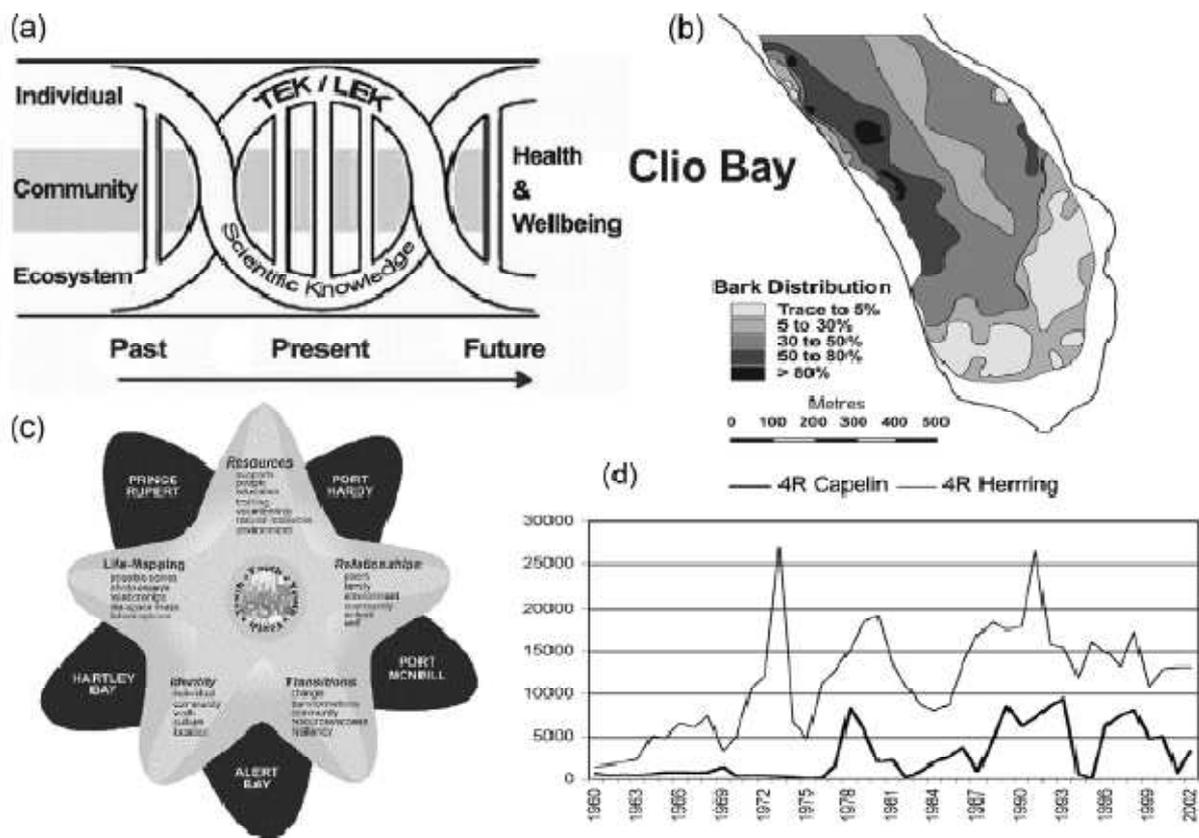


Figure 8: Examples of different disciplinary metrics: (a) feedback loops; (b) map; (c) organizational diagram; (d) graph. (From Ommer 2010, p.485)

Various metrics and techniques were used in CUSP to identify sub-components of the research and where they fitted within the overall programme, to communicate methodologies and frameworks, and to portray findings. Different metrics will be more effective at transferring knowledge and insight to different groups, and it is important to use a variety of means, accordingly. In the MTM programme, a wide range of approaches are used to

communicate research designs/methods and results including computer models such as hui/workshops; hikoi; powerpoint presentations with pictorial displays; face to face workshops and meetings with various end user groups; Systems Dynamics scenario models; GIS layers; videos of oral history interviews; informal korero (discussion); technical reports; summarised 'newsletter'-style reports; social media such as facebook, twitter, youtube; graphs, websites, journal articles, and papers/presentations at academic conferences such as this ISEE conference in Brazil.

The above models, frameworks and methodological approaches depicted in Section 3 above are by no means a comprehensive list of all relevant or insightful ideas identified in the literature. Many additional approaches have also been identified and applied by research in the MTM programme, and other related research. However, those described above are included here as varied examples of the diversity of perspectives and approaches that abound, which help researchers and practitioners to develop and implement research that aims to restore ecological and socio-cultural resilience and sustainability.

4. Conclusions and Recommendations for Sustainable Coastal Resource Management Research that also Builds Social and Cultural Resilience

The MTM research undertaken in Phase 1 facilitated 'end user' involvement and active engagement of local communities, and were a way of encouraging social learning and understanding of complex sustainability problems. This approach has enabled Māori and non-Māori, public and professionals, 'conservationists' and 'business representatives' to spend time sharing stories, local wisdom, hopes, and fears regarding the use and importance of coastal ecosystems in a personally-engaged manner (Hardy et al. 2011). Given the varying perspectives and value systems of different community groups regarding the use and value of coastal ecosystems, such inclusive participatory methods have proven very effective in building awareness the socio-cultural, economic and ecological impact of various coastal resources uses on different user groups.

The following suggestions are offered for future coastal research that can empower local communities to positively engage in coastal restoration and sustainable resource management, while at the same time building social and cultural resilience. These insights are offered here as ideas that have emerged from cross-cultural integrative research experiences in MTM (Hardy et al. 2011) and previous related research. Their usefulness or appropriateness in other contexts should be assessed in light of local conditions.

Typically, coastal research in New Zealand focuses on the species and process level, rather than on 'ecosystems' and their 'services'. MTM has begun to address this issue by explicitly considering coastal ecosystem services in terms of biophysical indicators and values, including mātauranga Māori indicators (Hardy et al. 2011). Advancing understanding amongst local communities, Councils, and other kaitiaki and end user groups, as well as within the research community itself, about concepts and frameworks for understanding 'Coastal Ecosystem Services' requires significant advancement in the capability of communities to actually understand how human activity impacts on coastal resources. To assist this understanding, approaches to restoration efforts must include a multi-dimensional, integrative systems view of ecosystem services. Phase 1 of MTM has identified the need for much greater emphasis on ecosystem services research, as well as 'education' about such concepts within the community and within decision-making bodies who manage coastal ecosystems (Hardy et al. 2011).

Further, the MTM research has begun the process of conceptualising and modelling coastal ecosystems and their services with our systems dynamics scoping model of Tauranga harbour, which utilised mediated modelling as a new ‘integrative’ coastal ecosystem management tool. This participatory approach to problem solving enabled a diversity of perspectives and cross-cutting ecological, economic, and cultural issues to be considered simultaneously. The result was an improved level of ‘knowledge integration’ within our MTM team and by the kaitiaki and end user group. Further enhancements to this model are planned as additional information comes to hand in Phase 2 of MTM. Additionally, MTM will examine coastal ecosystem services in greater detail, to increase the depth of understanding about the services provided by ecosystems in the coastal zone; currently, such knowledge is very limited, even within the academic literature.

Our collective understanding of coastal ecosystems, and their services and healthy functioning, needs to be bolstered. Greater community awareness about the significant degradation of some critical coastal ecosystems in both case study areas has already had an empowering effect in targeting future research and restoration activity to stem such decline, and to consider the ecological and socio-cultural impacts of economic activity when making decisions about the use of coastal resources. Significant advances are required to develop capability in systems thinking, mediated modelling, understanding of coastal ecosystems and their services and functioning. To improve the socio-environmental health for lands, waterways and peoples, the holistic nature of a Māori environmental world view must also be bolstered and vocalised by more local tangata whenua, or other local community groups in overseas locations (Hardy et al. 2011).

Although many international, national and local regulators and research funders have prioritised the critical importance of developing methods of environmental valuation to systematically account for natural resources as capital in the same way as we count nationally for economic and financial resources and “bridging this analysis into mainstream policy, planning processes and business decision-making”, this is not typically implemented in practice. Phase 1 of MTM not only highlighted the challenges of achieving these types of valuations of ecosystem services and capital, but also highlighted the need to take more account of cultural and more biocentric values (Hardy et al. 2011). Some useful case study examples of the valuation of coastal ecosystem services have begun and are planned to be completed in Phase 2. Furthermore, the development of the emergy-based methods for valuing coastal ecosystems has been demonstrated particularly in regard to how it highlights species and processes that may be overlooked by neoclassical methods of valuation such as contingent valuation (Hardy et al. 2011). Despite the success we have had in developing and operationalising neoclassical and emergy-based methods, more important challenges lie ahead for MTM in terms of how the results of such valuations can be used in a practical sense by both iwi and non-iwi resource managers.

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