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Article in *ECOLOGY AND SOCIETY* · December 2016

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Indigenous Māori values and perspectives to inform freshwater management in Aotearoa-New Zealand

Garth Harmsworth^{1,2}, Shaun Awatere^{2,3} and Mahuru Robb^{2,4}

ABSTRACT. In response to widespread water quality and quantity issues, the New Zealand Government has recently embarked on a number of comprehensive freshwater management reforms, developing a raft of national discussion and policy documents such as “Freshwater Reform 2013 and Beyond” and a National Policy Statement for freshwater management (NPS-FM 2014). Recent resource management reforms and amendments (RMA 2014), based on previous overarching resource management legislation (RMA 1991), set out a new approach and pathway to manage freshwater nationwide. Internationally, there is an increasing trend to engage with indigenous communities for research and collaboration, including indigenous groups as active participants in resource management decision making. What is driving this change toward more engagement and collaboration with indigenous communities is different for each country, and we document the progress and innovation made in this area in New Zealand. The indigenous rights of Māori in New Zealand are stated in the 1840 Treaty of Waitangi and in many forms of New Zealand’s legislation. Local and central governments are eager to include local indigenous Māori groups (iwi/hapū) in freshwater management planning processes through meaningful engagement and collaboration. Key to the success of collaborative planning processes for Māori are enduring relationships between local government and Māori, along with adequate resourcing for all partners contributing to the collaborative process. A large number of shared governance and management models for natural resource management have emerged in New Zealand over the past 20 years, and some recent examples are reviewed. We provide some discussion to improve understanding and use of the terms used in these management models such as cogovernance, comanagement, and coplanning, and describe some of the more important frameworks and tools being developed with Māori groups (e.g., iwi/hapū), to strengthen Māori capacity in freshwater management and to support good collaborative process and planning.

Key Words: *cogovernance; collaboration; comanagement; coplanning; cultural monitoring; cultural values; indigenous Māori; Māori knowledge; mātauranga Māori; resource management*

INTRODUCTION

Freshwater is one of New Zealand’s most precious resources, which has come under increasing pressure in the last 20 years (Land and Water Forum 2010, 2012a, b, Davies-Colley 2013, Parliamentary Commissioner for the Environment 2015). Concerns about the state of and trends in water quality and water quantity in New Zealand have been long-standing, but are now being seriously addressed by government, industry groups, Māori, and environmental managers in central and local government (Office of the Minister for the Environment 2009, Land and Water Forum 2010, 2012a, b, 2015).

This paper, a synthesis of more than 20 years of research, collates a large amount of material from a large number of projects (~> 15 studies) in which the authors have been involved. We highlight recent issues in freshwater management and comment on how Māori involvement and inclusion in decision making is developing through time.

The paper provides a summary of recent issues of and debates on freshwater management and legislative and policy reform in New Zealand as part of work funded under a government science-funded program entitled Values, Monitoring and Outcomes. It describes indigenous Māori involvement in freshwater decision making, first providing a basic description of Māori values and knowledge systems together with an outline of the relevant legislative and policy landscape in which New Zealand society operates. It then provides some of the Māori-led frameworks and tools that help inform collaborative processes and planning, identifying key tools and Māori frameworks that are essential for

building indigenous Māori capacity and therefore helping increase indigenous participation and collaborative discourse in freshwater management. These tools are integral for characterizing and articulating indigenous values, perspectives, and interests and thereby informing decision making processes.

Finally, this paper explores some of the emerging collaborative models that have developed under the Treaty of Waitangi and various legislative reforms and through which we seek to improve the understanding and use of terms such as collaborative governance, comanagement, and coplanning. A glossary of Māori, constitutional, and policy terms is given in Appendix 1. An understanding of key Māori words provides an essential insight into indigenous Māori knowledge and Māori involvement in collaborative process and decision making.

BACKGROUND AND CONTEXT

Indigenous Māori society

Traditionally, indigenous Māori lived in local tribal areas where ancestry (*whakapapa*) and beliefs (*te ao Māori*, values) linked Māori to their natural and spiritual environment and customary practices were reinforced through inter-generational knowledge and application. Colonization by the British from the mid-1800s had major impacts on the Māori population, especially Māori health, culture, language, social status, and loss of land, water, and natural resources (Durie 1998, King 2003). Despite these major changes, the basic tenets of traditional Māori society still remain strong and influence the way Māori construct tribal status and authority, manage their lands and resources, and relate to

¹Tribal: Te Arawa, Ngāti Tūwharetoa, Ngāti Raukawa, ²Landcare Research, ³Tribal: Ngāti Porou, ⁴Tribal: Ngāti Awa, Ngāti Ranginui

other agencies and government. The way traditional indigenous rights and membership are enacted in current legislation continues to provide robust debate and models of democratic and collaborative practice (Te Aho 2010, Ruru 2012).

Legislative frameworks

Māori rights, roles, and responsibilities are enshrined in the 1840 Treaty of Waitangi, upheld by the principles of the Treaty (see glossary at end of paper), and subsequently stated under many of New Zealand's legislative frameworks such as the Resource Management Act (RMA) 1991 (Durette 2010, Ruru 2009a, b, 2011a). The Waitangi Tribunal has articulated a number of resource-specific principles, including those that state that the spiritual and cultural significance of a freshwater resource can only be determined by *tāngata whenua* and their traditional rights (Te Wai Māori, 2008, Ruru 2009c, NIWA 2010, Te Aho 2010, Waitangi Tribunal 2011, Ruru 2012). The RMA 1991 directs regional councils, who are responsible for managing natural resources in New Zealand, to recognise and provide for the relationship of Māori and their culture and traditions with waters as a matter of national importance. The Local Government Act 2002 provides for democratic and effective local government that recognizes the diversity of New Zealand communities.

Current freshwater legislation

The most influential policy for the management of freshwater resources in recent years is the National Policy Statement for Freshwater Management (NPS-FM) 2014 (New Zealand Government 2014), which provides direction to local government on matters of national significance in reference to the RMA. Setting enforceable quality and quantity limits is a key purpose, so that regional councils and communities can more consistently and transparently plan for freshwater objectives.

The NPS-FM identifies 13 national values and uses for fresh water. Two of these national compulsory values apply to all water bodies: ecosystem health and human health for recreation. National bottom lines are set for the compulsory values and minimum acceptable states for the other national values. Reference in the NPS-FM is given to Māori values through an overarching framework called *Te Mana O Te Wai*, a concept that recognizes that fresh water is a natural resource the health of which is integral to the social, cultural, economic, and environmental well-being of communities.

The NPS-FM 2014 refers to the Treaty of Waitangi as the underlying foundation of the Crown/iwi/hapū relationship in regard to the management of freshwater resources (New Zealand Government 2014). This includes the need for collaborative planning, effective provisions for Māori involvement in freshwater planning and decision making, and the implementation of a national objectives framework. Using the treaty and subsequent legislative frameworks, processes, and policy statements, Māori seek increased status for decision making about natural resources, such as water, and therefore for actively participating in collaborative processes and the cogovernance of natural resources (Memon and Kirk 2012, Te Aho 2010, Ruru 2009a, b, c, d, 2011a, b, 2012, Waitangi Tribunal 2011).

Since the late 1990s, Treaty of Waitangi settlements (e.g., Waitangi Tribunal 2010, 2011) have played a critical role in providing the

legislative foundation for a range of cogovernance and comanagement institutional arrangements to manage freshwater resources and for the implementation of rehabilitation strategies and actions to meet Māori and community aspirations across rivers, wetlands, lakes, and catchments (e.g., Waikato River, Whanganui, Te Waihora, Te Arawa Lakes).

Profound national and local concerns and debates about resource management in New Zealand have been catalysts for exploring new styles of collaboration and governance. Desired outcomes and stated goals for improved freshwater management in New Zealand have often been reinforced through geographically explicit (e.g., river, lake, catchment) treaty settlement agreements, with specific sections and schedules asserting indigenous rights. These treaty responsibilities obligate the Crown and local government to have regard for indigenous relationships and rights, thus providing a sound legal and policy basis to increase Māori involvement in local governance, planning, and management decisions, and to recognize Māori values, uses, and interests, which requires a more inclusive and collaborative approach to freshwater management, especially at the local regional and catchment levels.

Internationally, there is an increasing trend to engage with indigenous communities in collaborative research where indigenous groups are active participants in resource management decision making (Dove 2006, McGregor 2014). What is driving this change toward more engagement and collaboration is different for each country, but many agencies and researchers are recognizing the importance and value of local and diverse perspectives and knowledge in both research and decision making (Houde 2007, Adams et al. 2014, Carothers et al. 2014, McGregor 2014, Velasquez Runk 2014) and the judicial and ethical frameworks that give effect to collaboration (Ruru 2009a, d, Nikolakis and Grafton 2014).

Evolving from these relationships and collaborations, are an increasing number of cogovernance and comanagement examples (Carlsson and Berkes 2005, Berkes 2009, Durette and Barcham 2009, Duff et al. 2010, Te Aho 2010, von der Porten and de Loë 2013a, b, Dodson 2014, Auditor General New Zealand 2016); methods for monitoring governance outcomes (Cundill and Fabricius 2010); and how to include indigenous groups in planning and policy (Duff et al. 2010, Tan and Jackson 2013, von der Porten and De Loë 2014).

A large number of shared governance and management models have therefore emerged in New Zealand over the past 20 years (Durette and Barcham 2009, Waikato River Authority 2011, Muru-Lanning 2012, Harmsworth et al. 2015, Robb et al. 2015). To help improve understanding, we examine some of these management models and discuss current terms being commonly used, such as governance (Ruru 2009a, Te Aho 2010, Fenemor et al. 2011), cogovernance (Muru-Lanning 2012, O'Brien 2012), comanagement (Carlsson and Berkes 2005, Berkes 2009, Memon and Kirk 2012), and coplanning (Duff et al. 2010, Awatere et al. 2012). Our recent research has found that the success of collaborative planning processes relies on enduring relationships between local government (regional councils) and Māori, along with adequate resourcing for all partners contributing to the collaborative process (Robb et al. 2015, Sinner and Harmsworth

2015). It is also a very long-term process based on solid relationships and trust, which needs a long-term horizon to truly measure benefits and outcomes (e.g., >~10-50 years). Many tools have been developed to help strengthen Māori capacity in freshwater management and to support effective collaborative process and planning. Some of the more important frameworks and tools being used by Māori groups (e.g., iwi/hapū) are described in this paper.

Māori freshwater values

Te Ao Māori (Māori world view) and mātauranga Māori (Māori knowledge systems) refer to a wide range of cultural concepts, values, knowledge systems, frameworks, ethics, and principles founded on traditional knowledge, philosophy, religion, and beliefs, giving rise to customary practice and a distinct set of indigenous cultural, physical, spiritual, and metaphysical values (Marsden 1988, Barlow 1993, Mead 2003, Awatere and Harmsworth 2014). The modern Māori world view, based on a mix of traditional, historic, and modern elements, can be used to articulate modern perspectives, issues, local interests, values, and resources (e.g., customary resources, mahinga kai). For example, in a modern context mātauranga Māori (e.g., traditional, holistic, local, and contemporary knowledge) has been used to construct modern Māori issues, perspectives, and realities (Durie 1998), aspirations and vision (Waikato River Authority 2011, TALT 2015), and tools and frameworks (Awatere and Harmsworth 2014, Robb et al. 2015), to develop Māori classifications of water and wetlands (Douglas 1984, Harmsworth 2002) and to construct tribal cultural histories as basis for understanding contemporary freshwater management (Tipa 2013).

The decline in water quality and quantity in many parts of New Zealand, as well as its state of mauri (life force, energy), is a significant issue for Māori (Te Wai Māori 2008, Harmsworth et al. 2014). This decline is typically represented in local tribal areas by widespread degradation of customary resources, including extensive habitat area reduction, low flows in rivers and streams, reduction in flora and fauna populations, and poor condition of ecosystems and resources (e.g., mahinga kai, taonga species, habitats).

Mātauranga Māori to inform collaborative processes

Mātauranga Māori is being increasingly used to inform collaborative processes to help manage freshwater ecosystems as councils, iwi/hapū groups, and communities engage collaboratively in decision making, planning, and managing natural resources (Awatere and Harmsworth 2012, Sinner and Harmsworth 2015). Tribal and generic Māori knowledge systems are used to determine the values to be managed and protected, and these can then be used in collaborative processes for comanagement and coplanning to achieve strategies and actions to support Māori values.

FRAMEWORKS AND TOOLS TO INFORM COLLABORATIVE PROCESS AND PLANNING

With the increased role of Māori in managing natural resources and the various legislative reforms focused on improving the management of freshwater resources, a number of guidelines and protocols have emerged to facilitate effective Māori engagement in these processes. Guidelines and protocols outlining appropriate

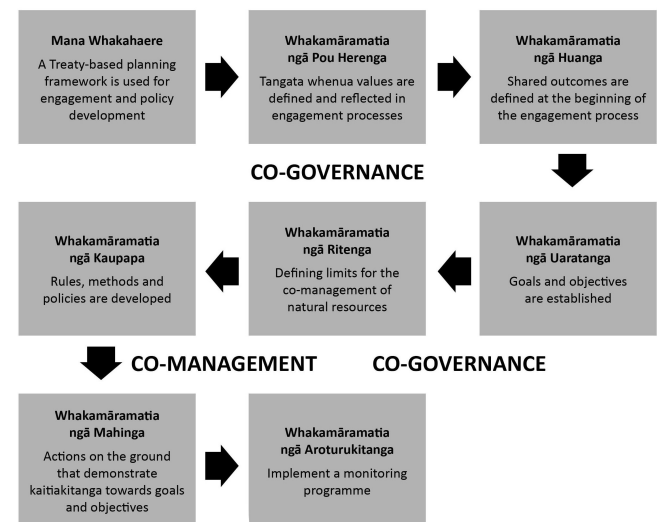
processes for Crown–council (regional and district)–Māori (iwi/hapū) engagement in New Zealand (e.g., Harmsworth 2005, Awatere et al. 2012, Sinner and Harmsworth 2015) have been developed, and these support good collaborative process and planning, as encouraged through the NPS-FM and proposed RMA reforms. A number of examples from across New Zealand (e.g., Harmsworth 2005, Robb et al. 2015) also provide important lessons and reflections for iwi/hapū engagement and Māori collaboration with the Crown and councils.

Kaupapa Māori-based (Māori centered, Māori knowledge based) frameworks and tools that have emerged to help different parts of a community articulate and demonstrate the value they place on a freshwater resource can be used individually, or in combination, to generate effective and meaningful Māori-Crown dialogue to support partnerships, cogovernance, and comanagement (e.g., Robb et al. 2015, Waikato Tainui 2015a, b). These all help achieve desired freshwater outcomes.

Māori frameworks

Tikanga-based frameworks: Tikanga are custom- and protocol-based actions that drive “correct” (tika) behavior. In this context, tikanga refers to processes for engagement. The building of meaningful relationships between the Crown and iwi/hapū is the foundation for any collaboration between treaty partners. These relationships should be maintained and strengthened over time and should exist beyond a single project. Tikanga-based frameworks (Awatere and Harmsworth 2014) are developed early with iwi/hapū (i.e., when forming the initial relationship) to guide collaborative processes, customary protocols, behavior, and responsibilities. Using a tikanga approach and process, a collaboration framework for working with Māori was developed by Robb et al. (2015) and Harmsworth et al. (2013), which is shown in Figure 1.

Fig. 1. An eight-step tikanga process to achieve desired freshwater planning and management outcomes for Māori (Robb et al. 2015).



Values-based frameworks: These type of frameworks identify, organize, and describe key Māori values as a basis for guiding and determining freshwater management (e.g., Ngā Matapono Ki Te Wai (TRONT 2013), Te Mana o te Wai (New Zealand Government 2014), Te Arawa Cultural Values Framework (TALT 2015), and Wai Ora Wai Māori (Awatere et al. 2015). Value-based frameworks can be used to set freshwater limits and standards connected to Māori values.

Cultural opportunities mapping and assessment: These are tools that provide a framework for incorporating cultural perspectives, values, and interests into freshwater management, contemporary resource management, and intergenerational planning (Tipa 2010, Tipa and Nelson 2012, Tipa and Severne 2010).

Māori tools

Iwi and hapū management plans: A large number of iwi/hapū management plans have been developed by various iwi/hapū since the 1990s (Durie 1998, Awatere et al. 2012), most in response to the RMA 1991 requirements to articulate Māori values for planning and policy. Many of these plans are now in the third generation and continue to evolve over time. They are an important source of information for articulating Māori issues, values, objectives, aspirations, and priorities within a given area, supported by local mātauranga Māori. These documents are important sources of information for collaborative processes and freshwater planning and hold iwi/hapū-specific and site-specific knowledge.

Geographic information systems (GISs): Used extensively in New Zealand since the mid-1990s. GIS information has often been collected in conjunction with iwi/hapū management plans and to support treaty claims and has become an important Māori tool used by many tribes and Māori organizations. In this context Māori knowledge has often been used to identify, record, classify, and map Māori values, significant sites, or special interest areas at accurate scales. GIS mapping improves the understanding and expression of locational Māori values in planning. Spatial and temporal mapping and assessment, and indigenous approaches to using GIS are well documented (e.g., Harmsworth 1997, 1998, TRONT 2003, 2007, Robb et al. 2015) and can be used to support aspects of collaborative freshwater management, such as modeling and scenario planning, and to identify priority areas for management and restoration.

Cultural monitoring: Sophisticated indigenous cultural monitoring and assessment methods and tools, developed in different parts of New Zealand, utilize mātauranga Māori and Western science to monitor progress toward goals and objectives, and changes in environmental health. These approaches have been developed in different parts of New Zealand and are continually adapted for local use (e.g., Harmsworth 2002, TRONT 2003, Townsend et al. 2004, Harmsworth and Tipa 2006, Tipa and Tierney 2006a, b, Jollands and Harmsworth 2007, Harmsworth et al. 2011, 2013, 2015, Harmsworth and Awatere 2013, Awatere and Harmsworth 2014, Robb et al. 2015). Cultural monitoring data are being used to varying degrees to inform and improve local and regional collaborative processes and enhance understanding of environmental health from a Māori perspective.

Cultural monitoring can be used to support Māori articulation of “values” for decision making and provide iwi/hapū with ways

to assess and manage freshwater, and monitor environmental-cultural changes in ways that are relevant to them (Harmsworth and Awatere 2011, Robb et al. 2015). Cultural monitoring tools can be used to contribute to, or inform, some formalized assessment (qualitative or quantitative) to show change or trends at varying spatial and temporal scales (Harmsworth et al. 2014). An extensive range of Māori-led cultural monitoring approaches, methods, and tools have been developed, trialled, tested, and used throughout Aotearoa-New Zealand, for example (Table 1).

An example of how Māori-led cultural monitoring can be used to support decisions within a collaborative process is outlined in the framework shown in Table 2. This shows the relationship between tangata whenua values, objectives, and monitoring tools, and provides some examples of the freshwater variables that can be managed through interventions to meet iwi/hapū objectives, goals, and long-term aspirations and outcomes, e.g., healthy waterways, restoration of the mauri of the river.

EMERGING MODELS: COGOVERNANCE, COPLANNING, AND COMANAGEMENT IN PRACTICE

A large number of shared governance and management models have emerged in New Zealand over the past 20 years (Ruru 2009a, Te Aho 2010, Dodson 2014, Harmsworth et al. 2015, Robb et al. 2015, Auditor General New Zealand 2016), many based on the treaty, reinforcing and bringing to life the legal status of cogovernance agreements. Under each model, governance structures, legal status, membership, agreements, and the collaborative process tend to vary markedly from council to council, and from region to region (Table 3, Fig. 2). Some of the best examples are where the Treaty of Waitangi claims and settlements have formed the basis of many statutory comanagement regimes shown in freshwater catchments, such as the Te Arawa Lakes, Te Waihora (Lake Ellesmere), and the Waikato and Waipa rivers.

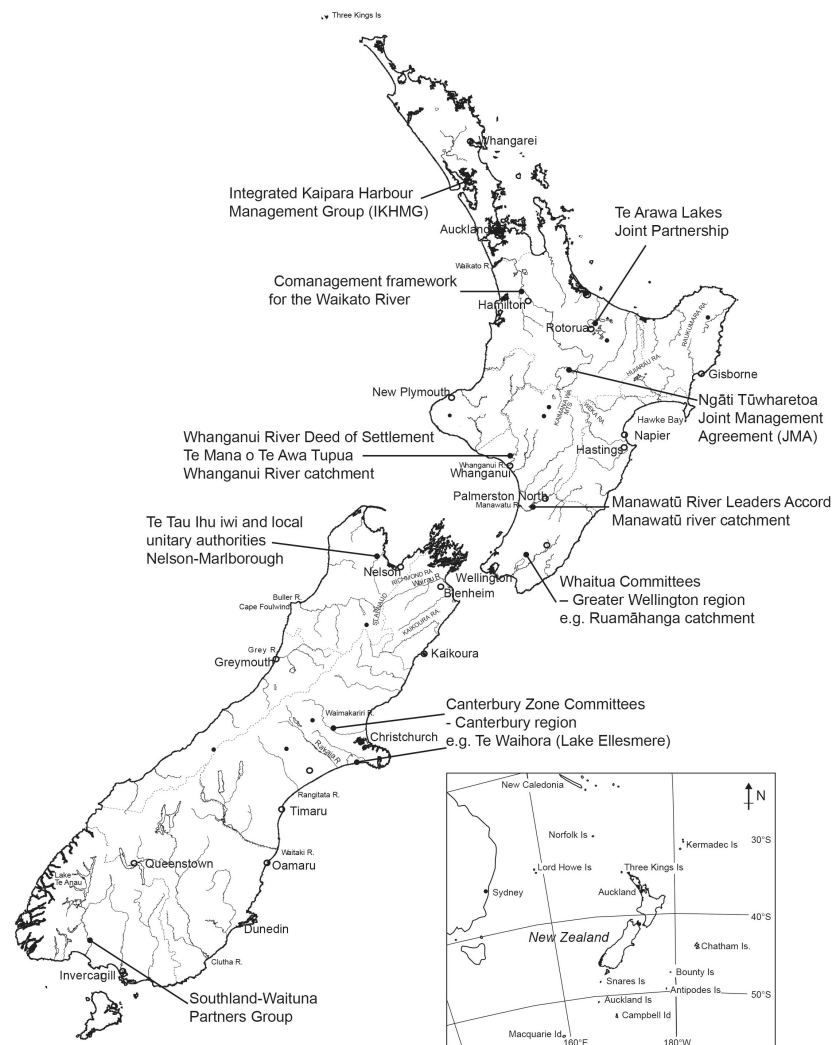
Local government, iwi/hapū groups, and communities are increasingly engaging in collaborative processes for decision-making, planning, and managing natural resources, and Māori more routinely play a critical role in the comanagement of freshwater (Table 3, Fig. 2). Freshwater, catchment, and resource management agreements typically intend to achieve mutually agreed outcomes, first, between iwi/hapū Māori and the Crown and delegated authorities (e.g. national government, regional councils, local authorities), and second, with other communities and stakeholders.

DISCUSSION

Internationally New Zealand stands out in terms of having one signed overarching treaty between the Crown, now represented by the New Zealand Government, and indigenous Māori groups (iwi/hapū) that crosses jurisdictions, agencies, and communities to recognize and acknowledge indigenous rights. These iwi/hapū groups are now represented in many modern forms and generally mandated by the community or constituency they represent (e.g., iwi authority, rūnanga).

Current legislation and policy are designed to embrace and respect the treaty and its principles. This has strengthened the rights of inclusion of indigenous peoples in decision-making processes and natural resource management across New Zealand. In more

Fig. 2. Location of selected Māori cogovernance and comanagement models in New Zealand.



recent years it has given rise to collaborative processes for resource decision making, and a number of cogovernance and comanagement arrangements and models. However, the terms cogovernance, coplanning, and comanagement are often used interchangeably and are not well defined, which increases confusion about the role of Māori and the expectations of different Māori groups alongside the responsibilities and representation of local government (e.g., councils) within this collaborative process. The following explanations and definitions were developed in 2015 from an indigenous Māori perspective (Harmsworth et al. 2015, Robb et al. 2015) to provide clarity and inform discussion:

- **Cogovernance:** Formal arrangement to share decision making. In terms of iwi/hapū and the Crown, this should be based on the Treaty of Waitangi. Through principles and collaborative guidelines, the treaty provides the basis for

meaningful ongoing relationships. Cogovernance agreements between iwi/hapū and the Crown are essential early on in a collaborative process.

- **Coplanning:** Planning together under cogovernance agreements. Coplanning is a shared process where iwi/hapū/tangata whenua interests and values, and the use and understanding of mātauranga Māori, are incorporated into local or regional planning, including the development of policies, goals, and objectives in council, regional and district plans, and/or urban design.
- **Comanagement:** Actions and responsibilities implemented jointly by the parties. Comanagement involves deciding how a desired goal, objective, or outcome is best achieved (e.g., catchment, wetland, and farm plans, consents, riparian planting, river clean-ups, restoration, etc.). Iwi/hapū groups work together with partner agencies.

Table 1. Key Māori-led cultural monitoring approaches in Aotearoa-New Zealand

Name of approach	Specific examples	Selected references
Taonga (e.g., flora and fauna) species sampling, monitoring reporting, harvesting	Kōura (freshwater crayfish)	Kusabs et al. (2015a, b)
	Tuna (eel)	Williams et al. (2014)
	Freshwater mussels	Rainforth (2008)
Cultural habitats	Kanakana/pihirau-lamprey	Te Ao Marama Incorporated and Waikawa Whānau (2010)
	Native fish species such as <i>Galaxiids</i> spp., e.g., inanga, kōkopu, koaro	Kitson et al. (2012) Morris et al. (2013)
	Plants such as kuta, raupō, harakeke, etc. Mahinga kai, cultural harvest sites	Kapa and Clarkson (2009) Maxwell and Penetito (2007); Stewart et al. (2014)
Contaminants	Risk, customary resources	NIWA (2016); Stewart et al. (2014)
Report cards	2016 Pilot Waikato River report card: methods and technical summary	Williamson et al. (2016)
The Cultural Health Index (CHI) for rivers and streams	Framework and methods guided by river iwi	
	CHI method and application: has been used extensively by iwi/hapū groups to inform decisions, and provide knowledge to support collaborative processes (https://www.mfe.govt.nz/sites/default/files/chi-for-streams-and-waterways-feb06-full-colour.pdf)	Tipa (1999); Tipa and Tierney (2003, 2006a, b); Townsend et al. (2004); Pauling et al. (2007); Nelson and Tipa (2012); Tipa and Nelson (2012); Tipa and Associates (2013)
	Adaptations have been made for freshwater and estuarine environments	Young et al. (2002); Townsend et al. (2004); Taranaki District Council (2007); Hughey and Taylor (2009); Walker (2009); Harmsworth et al. (2011)
Baselines	Cultural health assessment	Pauling et al. (2005)
Cultural flow	Cultural flow preference studies	Tipa (2009, 2012); Tipa and Severne (2010); Tipa and Nelson (2012); Tipa and Associates (2013); Rainforth (2014)
Historic data and information	Mapping of Māori values, historic places, cultural resources, etc.	Harmsworth (1997, 1998); Tipa (2013)
Significance assessment method	Significance assessment method for determining Māori values/tangata whenua river values	Tipa (2010)
Tribal/regional state of environment reporting: State of Takiwā	A “toolbox” for iwi environmental monitoring and reporting: Te Waipounamu/South Island, developed by the iwi Ngai Tahu	Mattingley and Pauling (2005); Pauling et al. (2007); TRONT (2003, 2007); Pauling (2010)
Wetlands	National monitoring approaches and indicators of wetlands Wetland habitats along the Waikato west coast, e.g., Toreparu wetland assessment approach	Harmsworth (2002) Robb (2014)
Mauri assessments	The Mauri model and “mauri o meter” (http://www.mauriometer.com/) Mauri of Waterways Kete and Framework The Mauri compass	Morgan (2006, 2007a, b, 2015); Morgan et al. (2013) Jefferies and Kennedy (2009) Ruru (2014, 2015)
Science and cultural indicators	Linking cultural and science indicators	Harmsworth et al. (2011)
Kaitiaki tools (guardianship tools)	Kaitiaki tools: an Internet-based iwi resource management planning tool (https://www.niwa.co.nz/freshwater/management-tools/water-quality-tools/kaitiaki-tools)	NIWA (2016)
Ngā Waihotanga Iho (estuarine assessment tools)	Ngā Waihotanga Iho: Iwi Estuarine Monitoring Toolkit	Rickard and Swales (2009a, b)

The emergence of these new collaborative relationships between the Crown (or delegated Crown agencies such as a regional council) and iwi/hapū are not without their challenges. These may highlight the issue of power sharing in newly formed arrangements between Māori and government and requirements for improved clarity of the role of the Treaty of Waitangi in local government, and uncertainty about rights, representation, and membership of iwi/hapū in the collaborative process. For

example, there are few examples of effective coplanning in New Zealand between councils and iwi/hapū (Awatere et al. 2012). Ideally, coplanning should occur before comanagement, but the paucity of coplanning probably reflects the power and capacity imbalance between councils with authority, dedicated resources, and legislative function, and Maori groups who lack resources, capacity, and a specific participatory role. This places another stress on effective participation in the collaborative planning process.

Table 2. Cultural monitoring to assess freshwater limits to maintain/enhance cultural values.

Values	Objectives	Performance measures/tools	Management variables (examples)
Kaitiakitanga Mauri Mahinga kai	Set limits to restore the mauri of freshwater, cultural resources, mahinga kai areas (define standards/limits/bottom lines to support life-supporting capacity/ecological integrity for taonga spp. and habitats)	Monitoring such as Cultural Health Index and mauri assessment; identify change/trends in the state or mauri Abundance/condition of cultural resources, taonga spp., mahinga kai	Minimum flows Nutrient management/reduction Water clarity and sediment loads Habitat extent and condition Groundwater-surface water Connectivity Pathogens (e.g., <i>E. coli</i>) levels Stock exclusion Catchment management-land use

Table 3. Indigenous Māori involvement in collaborative processes and freshwater management in New Zealand.

Existing model and location	Structure and agreement	Examples of collaborative process
Integrated Kaipara Harbour Management Group (IKHMG) Kaipara harbour	Agreement between iwi, Kaipara community, Crown agencies, local government, industry, and nongovernmental organizations	Comanagement and some coplanning: established in 2005 to promote integrated harbor management, kaitiakitanga, and interagency coordination
Comanagement framework for the Waikato River Waikato River	Joint management agreements (JMAs) based on Waikato-Tainui Raupatu Claims Settlement Act 2010. Waikato River Authority (WRA) established 2010 as cogovernance entity. Agreement between the Crown and five river iwi	Cogovernance, comanagement (JMAs), and some coplanning: to implement Te Ture Whaimana o Te Awa o Waikato Vision and Strategy for the Waikato River
Te Arawa Lakes Joint Partnership Rotorua Lakes region	Based on 2004 Deed of Settlement Te Arawa and the Crown, joint partnership between Te Arawa Lakes Trust, Bay of Plenty Regional Council, and the Rotorua District Council to comanage the Rotorua Lakes	Cogovernance and comanagement, shared decision making
Ngāti Tūwharetoa Joint Management Agreement Taupō district	JMA (2008) between Taupō District Council and Tūwharetoa Māori Trust Board	Cogovernance and comanagement: resource consents and private plan hearings
Whanganui River Deed of Settlement Te Mana o Te Awa Tupua Whanganui River catchment	Ruruku Whakatupua, the Whanganui River Deed of Settlement 2014: Agreement between Whanganui iwi and the Crown	New legal framework, cogovernance and comanagement, Statutory decision making and collaborative process
Manawatu River Leaders Accord Manawatu river catchment	Agreement/signed 2010 accord between regional council, local council, community, and iwi: joint action to improve state of river	Cogovernance Focus, vision, goals defined
Whaitua committees - Greater Wellington region e.g., Ruamāhanga catchment	Overarching Greater Wellington Regional Council (GWRC) Te Upoko Taiao committee and catchment/regional Whaitua committees established—joint GWRC, iwi, and community	Māori representation on all committees; collaborative freshwater processes, partnerships, good engagement practice for freshwater management
Te Tau Ihu iwi and local unitary authorities Nelson-Marlborough	Claims Settlement Bill, Memorandum of Understanding, iwi interests, agreement between iwi and three local government authorities to manage freshwater	Shared decision making via pan-iwi rivers and under Deed of Settlement: Freshwater Advisory Committee established
Canterbury Zone committees Canterbury region e.g., Te Waihora (Lake Ellesmere)	Managed by Environment Canterbury, Regional Management committee established, 2009 Canterbury Water Management Strategy, water zone management committees	Integrative collaborative planning approach, implementation plans for each zone, decision making to implement and meet targets
Southland-Waituna Partners Group	Established 2013 comprising multiple agencies with a statutory responsibility for management (government, local, district, iwi).	Shared decision making under a terms of reference (TOR) binds the agencies and records the relationship of parties (“the Partners”); how they will work together to improve the environmental health of Waituna Lagoon and catchment

CONCLUSIONS

The integration of indigenous knowledge into freshwater management science, policy, and practice is being considered in numerous jurisdictions around the world. New Zealand provides an exemplar of engagement in this space that has led to the adoption of indigenous concepts within a national policy framework. Freshwater management strongly reflects indigenous rights exemplified under the 1840 Treaty of Waitangi, which provides the essential foundation for forming meaningful relationships and partnerships between government and the local district tribes: iwi/hapū. The New Zealand experience also illustrates the challenges of integrating different value sets and knowledge traditions as part of the governance and management regime. Cogovernance, coplanning, and comanagement are important terms within freshwater management and require clarification and understanding for ongoing use and application.

Treaty principles (e.g., relationships, partnership, consensus, trust, respect) can guide good collaborative process and decision making from start to finish (Harmsworth et al. 2013, Sinner and Harmsworth 2015, Robb et al. 2015). When working with indigenous groups, collaboration is shown to be most successful when the indigenous groups are involved from the outset in setting the terms of reference and determining membership, and when there is understanding, respect, and acknowledgement of different perspectives, values, issues, and knowledge systems throughout the collaborative process, with adequate resourcing that builds capacity on both sides, i.e., government and Māori).

Key to the success of collaborative processes are enduring relationships between local government and tangata whenua, along with adequate resourcing for all partners. As shown in this research, collaborative processes can be supported by a variety of kaupapa Māori-based frameworks and assessment tools (Awatere and Harmsworth 2014, Harmsworth et al. 2015, Robb et al. 2015) to promote greater understanding and appreciation of Māori knowledge and values. These can be used at various stages along the collaborative, planning, or decision-making pathway. The success of a collaborative approach needs to be measured or evaluated over a longer time frame (i.e. >~3 yrs) using key indicators, to meet goals, objectives, and desired outcomes.

Māori-led guidelines, protocols, frameworks, and tools provide deeper understanding of Māori values, perspectives, and knowledge systems (mātauranga Māori), which can build bicultural capacity for iwi/hapū, and for central and local government, to improve collaborative processes to reach desired outcomes. Although the context for this paper is New Zealand, it has broader implications for indigenous people in resource management decision making elsewhere in that it demonstrates how indigenous frameworks and tools can be used to underpin and provide a basis for more inclusive decision-making processes.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/8804>

Acknowledgments:

This work was funded by the Ministry of Business, Innovation, and Employment (MBIE) in the programme Values, Monitoring and Outcomes (VMO) under contract C09X1003. We thank Andrew Fenemor (Landcare Research), Suzie Greenhalgh (Landcare Research), Lena Henry (planning, Auckland University), and two anonymous reviewers for valuable comments made on this paper, and Anne Austin (Landcare Research) for editing the manuscript.

LITERATURE CITED

- Adams, M. S., J. Carpenter, J. A. Housty, D. Neasloss, P. C. Paquet, C. Service, J. Walkus, and C. T. Darimont. 2014. Toward increased engagement between academic and indigenous community partners in ecological research. *Ecology and Society* 19(3):5. <http://dx.doi.org/10.5751/ES-06569-190305>
- Auditor General New Zealand. 2016. *Principles for effectively co-governing natural resources*. Presented to the House of Representatives under section 20 of the Public Audit Act 2001. New Zealand Government, Wellington, New Zealand. [online] URL: <http://www.oag.govt.nz/2016/co-governance/docs/co-governance-amended.pdf>
- Awatere, S., and G. Harmsworth. 2014. *Ngā Aroturukitanga tika mō ngā Kaitiaki: summary review of mātauranga Māori frameworks, approaches, and culturally appropriate monitoring tools for management of mahinga kai*. Landcare Research contract report LC1774. Landcare Research, Hamilton, New Zealand.
- Awatere, S., G. Harmsworth, S. Rolleston, and C. Pauling. 2012. Kaitiakitanga o ngā ngahere pōhatu: Kaitiakitanga of urban settlements. Pages 236-259 in T. Jojola, D. Natcher, and R. Walker, editors. *Reclaiming indigenous planning*. McGill-Queen's University Press, Montreal, Quebec, Canada.
- Awatere, S., M. Robb, and G. Harmsworth. 2015. *Proposed Mana Whenua values, attributes and measures for Auckland Council's Wai Ora Wai Māori programme*. Landcare Research contract report LC2319 for Auckland Council. Landcare Research, Auckland, New Zealand.
- Barlow, C. 1993. *Tikanga Whakaaro: key concepts in Māori culture*. Oxford University Press, Auckland, New Zealand.
- Berkes, F. 2009. Evolution of co-management: role of knowledge generation, bridging organisations and social learning. *Journal of Environmental Management* 90(5):1692-1702. <http://dx.doi.org/10.1016/j.jenvman.2008.12.001>
- Carlsson, L., and F. Berkes. 2005. Co-management: concepts and methodological implications. *Journal of Environmental Management* 75(1):65-76. doi: <http://dx.doi.org/10.1016/j.jenvman.2004.11.008>
- Carothers C. M., M. Moritz, and R. Zarger 2014. Introduction: conceptual, methodological, practical, and ethical challenges in studying and applying indigenous knowledge. *Ecology and Society* 19(4):43. <http://dx.doi.org/10.5751/ES-07212-190443>
- Cundill, G., and C. Fabricius. 2010. Monitoring the governance dimension of natural resource co-management. *Ecology and*

- Society 15(1):15. [online] URL: <http://www.ecologyandsociety.org/vol15/iss1/art15/>
- Davies-Colley, R. J. 2013. River water quality in New Zealand: an introduction and overview. Pages 432-447 in J. R. Dymond, editor. *Ecosystem services in New Zealand—conditions and trends*. Manaaki Whenua Press, Lincoln, New Zealand. [online] URL: http://www.landcareresearch.co.nz/_data/assets/pdf_file/0009/77058/2_12_Davie-Colley.pdf
- Dodson, G. 2014. Co-governance and local empowerment? Conservation partnership frameworks and marine protection at Mimiwhangata, New Zealand. *Society & Natural Resources* 7 (25):521-539. <http://dx.doi.org/10.1080/08941920.2013.861560>
- Douglas, E. M. K. 1984. *Waiora, Wai Māori, Waitai, Waikino, Waimate: Māori perceptions of water and the environment*. Occasional Paper No. 27. Centre for Māori Studies and Research, University of Waikato, Hamilton, New Zealand.
- Dove, M. R. 2006. Indigenous peoples and environmental politics. *Annual Review of Anthropology* 35:191-208. <http://dx.doi.org/10.1146/annurev.anthro.35.081705.123235>
- Duff, N., K. Delfau, and M. Durette. 2010. *A review of Indigenous involvement in water planning*. Prepared by Synexe for the National Water Commission. National Water Commission, Australia.
- Durette, M. 2010. A comparative approach to Indigenous legal rights to freshwater: key lessons for Australia from the United States, Canada and New Zealand. *Environmental and Planning Law Journal* 27:296-315.
- Durette, M., and M. Barcham. 2009. *Indigenous water governance: an integrated approach to resource management*. Synexe Inc. Prepared for Ngā Pae o Te Māramatanga. Ngā Pae o Te Māramatanga, Auckland University, Auckland, New Zealand.
- Durie, M. 1998. *Te Mana te Kawanatanga*. Oxford University Press, Auckland, New Zealand.
- Fenemor, A., D. Neilan, W. Allen, and S. Russell. 2011. Improving water governance in New Zealand—stakeholder views of catchment management processes and plans. *Policy Quarterly* 7 (4):10-19.
- Harmsworth, G. 2005. *Good practice guidelines for working with tangata whenua and Māori organisations: consolidating our learning*. Landcare Research contract report LC 0405/091 for the ICM web site. Landcare Research, Lincoln, New Zealand.
- Harmsworth, G., S. Awatere, and J. Procter. 2014. *Meeting water quality and quantity standards to sustain cultural values*. 21st Century Watershed Technology Conference and Workshop, Improving Water Quality and the Environment, The University of Waikato, New Zealand, 3-7 November 2014.
- Harmsworth, G., S. Awatere, and M. Robb. 2015. *Māori values and perspectives to inform collaborative processes and planning for freshwater management*. Policy Brief No. 14 (ISSN: 2357-1713). Māori and Freshwater Planning. Freshwater Values, Monitoring and Outcomes (VMO) programme (MBIE contract: C09X1003). Landcare Research, Hamilton, New Zealand. [online] URL: http://www.landcareresearch.co.nz/_data/assets/pdf_file/0009/111042/PB_14_Maori_Values_Perspectives.pdf
- Harmsworth, G. R. 1997. Māori values and GIS: the New Zealand experience. *GIS Asia Pacific: The Geographic Technology Publication for the Asia Pacific Region* April:40-43.
- Harmsworth, G. R. 1998. Indigenous values and GIS: a method and framework. Netherlands Organisation for International Cooperation in Higher Education (Nuffic). *Indigenous Knowledge and Development Monitor* 6(3):3-7.
- Harmsworth, G. R. 2002. *Coordinated monitoring of New Zealand wetlands, phase 2, goal 2: Māori environmental performance indicators for wetland condition and trend*. A Ministry for the Environment SMF Funded Project - No. 5105. Landcare Research Report LC 0102/099. Manaaki Whenua—Landcare Research, Palmerston North, New Zealand. [online] URL: http://www.landcareresearch.co.nz/research/sustainablesoc/social/Maori_indicators.asp
- Harmsworth, G. R., and S. Awatere. 2013. Indigenous Māori knowledge and perspectives of ecosystems. Pages 274-286 in J. R. Dymond, editor. *Ecosystem services in New Zealand—conditions and trends*. Manaaki Whenua Press, Lincoln, New Zealand.
- Harmsworth, G. R., S. Awatere, and C. Pauling. 2013. *Using mātauranga Māori to inform freshwater management*. Landcare Research Policy Brief. Integrated Valuation and Monitoring Framework for Improved Freshwater Outcomes (C09X1003). Landcare Research, Lincoln, New Zealand. [online] URL: http://www.landcareresearch.co.nz/_data/assets/pdf_file/0003/74433/Policy-Brief-7-Using-Maori-to-inform-freshwater.pdf
- Harmsworth, G. R., and G. Tipa. 2006. *Māori environmental monitoring in New Zealand: progress, concepts, and future direction*. Report for the ICM website. Landcare Research, Lincoln, New Zealand. [online] URL: http://icm.landcareresearch.co.nz/knowledgebase/publications/public/2006_Maorienvmonit%20paper.pdf
- Harmsworth, G. R., R. G. Young, D. Walker, J. E. Clapcott, and T. James. 2011. Linkages between cultural and scientific indicators of river and stream health. *New Zealand Journal of Marine and Freshwater Research* 45(3):423-436. <http://dx.doi.org/10.1080/00288330.2011.570767>
- Houde, N. 2007. The six faces of traditional ecological knowledge: challenges and opportunities for Canadian co-management arrangements. *Ecology and Society* 12(2):34. [online] URL: <http://www.ecologyandsociety.org/vol12/iss2/art34>
- Hughey, K. F. D., and K. J. W. Taylor, editors. 2009. *Te Waihora Lake Ellesmere: state of the lake and future management*. EOS Ecology, Christchurch, New Zealand. [online] URL: <http://www.wet.org.nz/wp-content/uploads/2009/10/Ch08-Cultural-health-of-the-lake.pdf>
- Jefferies, R., and N. Kennedy. 2009. *Māori outcome evaluation: a kaupapa Māori, outcomes and indicators, framework and methodology*. International Global Change Institute, University of Waikato, Hamilton, New Zealand.
- Jollands, N., and G. Harmsworth. 2007. Participation of indigenous groups in sustainable development monitoring: rationale and examples from New Zealand. *Journal of the International Society for Ecological Economics* 62(3-4):716-726. <http://dx.doi.org/10.1016/j.ecolecon.2006.09.010>

- Kapa, M. M., and B. D. Clarkson. 2009. Biological flora of New Zealand 11. *Eleocharis sphacelata*, kuta, paopao, bamboo spike sedge. *New Zealand Journal of Botany* 47(1):43-52. [online] URL: <http://www.tandfonline.com/doi/pdf/10.1080/00288250909509792>
- King, M. 2003. *The Penguin history of New Zealand*. Penguin, Wellington, New Zealand.
- Kitson, J., V. Leith, D. Whaanga, J. Hay, A. Quartermann, S. Ledington, and C. Pauling. 2012. *Kanakana Harvest Mātauranga: potential tools to monitor population trends on the Waikawa River, Southland/Murihiku (A Scoping Project)*. Final Technical Report for Ngā Pae o Te Māramatanga. Ngā Pae o Te Māramatanga, Auckland University, Auckland, New Zealand.
- Kusabs, I. A., B. J. Hicks, J. M. Quinn, and D. P. Hamilton. 2015b. Sustainable management of freshwater crayfish (kōura, *Paraneophrops planifrons*) in Te Arawa (Rotorua) lakes, North Island, New Zealand. *Fisheries Research* 168:35-46. <http://dx.doi.org/10.1016/j.fishres.2015.03.015>
- Kusabs, I. A., J. M. Quinn, and D. P. Hamilton 2015a. Effects of benthic substrate, nutrient enrichment and predatory fish on freshwater crayfish (kōura, *Paraneophrops planifrons*) population characteristics in seven Te Arawa (Rotorua) lakes, North Island, New Zealand. *Marine and Freshwater Research* 66(7):631-643. <http://dx.doi.org/10.1071/MF14148>
- Land and Water Forum. 2010. *Report of the Land and Water Forum: a fresh start for fresh water*. Land and Water Forum, Wellington, New Zealand.
- Land and Water Forum. 2012a. *Second report of the Land and Water Forum: setting limits for water quality and quantity, and freshwater policy- and plan-making through collaboration*. Land and Water Forum, Wellington, New Zealand.
- Land and Water Forum. 2012b. *Third report of the Land and Water Forum: managing water quality and allocating water*. Land and Water Forum, Wellington, New Zealand.
- Land and Water Forum. 2015. *Fourth report of the Land and Water Forum: November 2015. Maximising the economic benefit of freshwater*. Land and Water Forum, Wellington, New Zealand.
- Mattingley, B., and C. Pauling. 2005. *State of the takiwa: cultural monitoring and reporting on the health of our environment: development of the takiwa database*. Te Rūnanga o Ngāi Tahu, Christchurch, New Zealand.
- Marsden, M. 1988. *The natural world and natural resources. Māori value systems and perspectives*. Resource Management Law Reform Working paper 29. Part A. Ministry for the Environment, Wellington, New Zealand.
- Maxwell, K. H., and W. Penetito. 2007. How the use of rāhui for protecting taonga has evolved over time. *MAI Review* 2:1-15.
- McGregor, D. 2014. Traditional knowledge and water governance: the ethic of responsibility. *AlterNative: An International Journal of Indigenous Peoples* 10(5):493-507.
- Mead, H. 2003. *Tikanga Māori: living by Māori values*. Huia Publishers and Te Whare Wananga o Awanuiarangi, Wellington, New Zealand.
- Memon, P. A., and N. Kirk. 2012. Role of indigenous Māori people in collaborative water governance in Aotearoa/New Zealand. *Journal of Environmental Planning and Management* 55(7):941-959. <http://dx.doi.org/10.1080/09640568.2011.634577>
- Morgan, T. K. K. B. 2006. Decision-support tools and the indigenous paradigm. *Engineering Sustainability* 159:169-177. <http://dx.doi.org/10.1680/ensu.2006.159.4.169>
- Morgan, T. K. K. B. 2007a. *Translating values and concepts into a decision-making framework: application of the Mauri model for integrated performance indicator assessment*. National Workshop, 5-7 September 2007. Roundtable on sustainable forests: a partnership for the future. Forest Products Laboratory, Madison, Wisconsin, USA.
- Morgan T. K. K. B. 2007b. Waioara and cultural identity. Water quality assessment using the Mauri model. *AlterNative: An International Journal of Indigenous Peoples* 3(1):42-67.
- Morgan, T. K. K. B. 2015. *How can Mātauranga Māori contribute to the Rena disaster response?* Contract 12RF01 Final Report. Auckland University, Auckland, New Zealand. <http://www.maramatanga.ac.nz/sites/default/files/Contract%20Report%2012RF01%20Morgan%20FINAL.pdf>
- Morgan, T. K. K. B., T. N. Fa'au, and R. D. Manuel. 2013. *Decision making at the interface: Mauri and its contribution to the Rena recovery*. SCANew Zealand. [online] URL: <http://www.mauriometer.com/userfiles/Decision%20making%20at%20the%20Interface%20Mauri%20and%20its%20contribution%20to%20the%20Rena%20Recovery.pdf>
- Morris, B., C. van Schravendijk-Goodman, J. Williams, and G. Ormsby. 2013. Identifying traditional whitebait stands in the lower Waikato River—a joint spatial analysis project. Waikato Regional Council Technical Report 2013/18. Waikato Regional Council, Hamilton, New Zealand. [online] URL: <http://www.waikatoregion.govt.nz/TR201318/>
- Muru-Lanning, M. 2012. The key actors of Waikato River co-governance: situational analysis at work. *AlterNative: An International Journal of Indigenous Peoples* 8(2):128-136.
- National Institute of Water and Atmospheric Research (NIWA). 2010. *Waikato River independent scoping study*. NIWA Client Report: HAM2010-032. NIWA, Hamilton, New Zealand.
- National Institute of Water and Atmospheric Research (NIWA). 2016. Kaitiaki tools. NIWA, Wellington, New Zealand. [online] URL: <https://www.niwa.co.nz/freshwater/management-tools/water-quality-tools/kaitiaki-tools>
- New Zealand Government. 2014. *National Policy Statement for Freshwater Management 2014*. Ministry for the Environment, Wellington, New Zealand. [online] URL: <http://www.mfe.govt.nz/publications/fresh-water/national-policy-statement-freshwater-management-2014>
- Nelson, K., and G. Tipa. 2012. *Cultural indicators, monitoring frameworks & assessment tools*. Tipa & Associates, Christchurch, New Zealand.
- Nikolakis, W., and R. Q. Grafton. 2014. Fairness and justice in Indigenous water allocations: insights from Northern Australia. *Water Policy* 16:19-35. <http://dx.doi.org/10.2166/wp.2014.206>

- Office of the Minister for the Environment. 2009. *New start for fresh water*. Minister for the Environment, Wellington, New Zealand. [online] URL: <http://www.mfe.govt.nz/more/cabinet-papers-and-related-material-search/cabinet-papers/freshwater/new-start-fresh-water>
- O'Brien, M. 2012. *Review of collaborative governance: factors crucial to the internal workings of the collaborative process*. Research Report CR 135 prepared for the Ministry of Environment. Ministry for the Environment, Wellington, New Zealand.
- Parliamentary Commissioner for the Environment. 2015. *Update report—water quality in New Zealand: land use and nutrient pollution*. Parliamentary Commissioner for the Environment, Wellington, New Zealand.
- Pauling, C. 2010. *Making Mātauranga matter: the role of cultural monitoring and health assessment in water management*. Presented at the Critical and Sensitive Research Issues Symposium (CSRI) 2010, Tangaroa Ki Uta, Tangaroa Ki Tai: Water, Our Future. Hosted by Ngā Pae o te Māramatanga. 15 November 2010, Christchurch, New Zealand.
- Pauling, C., T. M. Lenihan, M. Rupene, N. Tirikatene-Nash, and R. Couch. 2007. *State of the Takiwā: Te Āhuatanga o Te Ihutai. Cultural health assessment of the Avon-Heathcote Estuary and Catchment*. Te Rūnanga o Ngāi Tahu, Christchurch, New Zealand. [online] URL: <http://www.ngaaho.Maori.nz/documents/resources/20100914212427StateoftheTakiwa.pdf>
- Pauling, C., B. Mattingley, and J. Aitken. 2005. *Te ahuatanga o te waiaumdas—cultural health baseline report 2005*. Report for Te Rūnanga o Ngāi Tahu and the Ministry for the Environment. Ministry for the Environment, Wellington, New Zealand.
- Rainforth, H. J. 2008. *Tiakina Kia Ora—protecting our freshwater mussels*. Thesis. Victoria University of Wellington, Wellington, New Zealand. [online] URL: <http://researcharchive.vuw.ac.nz/xmlui/handle/10063/839>
- Rainforth, H. 2014. *A difficult convert? Combining cultural assessments and the IFIM to determine flow setting*. Presented at the joint conference for the New Zealand Hydrological Society, New Zealand Freshwater Sciences Society and IPENew Zealand Rivers Group. 2014 Water Symposium Integration: The Final Frontier. 24-28 November 2014.
- Rickard, D., and A. Swales 2009a. Field trials of Ngā Waihotanga Iho. *Water and Atmosphere* 17(1):9.
- Rickard, D., and A. Swales 2009b. Ngā Waihotanga Iho—the estuarine monitoring toolkit for iwi. *New Zealand Coastal Society Coastal News* 40:1-3.
- Robb, M. 2014. *When two worlds collide: Mātauranga Māori, science and health of the Toreparu wetland*. Thesis. University of Waikato, Hamilton, New Zealand.
- Robb, M., G. Harmsworth, and S. Awatere, 2015. *Māori values and perspectives to inform collaborative processes and planning for freshwater management*. Landcare Research contract report LC2119. Landcare Research, Lincoln, New Zealand.
- Ruru, I. 2014. *The Mauri compass. Te Runanga o Turanganui a Kiwa Internal Memo to Kahui Kaumatua*. 14 August 2014. <http://www.mauricompass.com/>
- Ruru, I. 2015. *The mauri compass. A concept paper showing the mauri compass as an evaluation tool in a RMA Freshwater context*. Te Rūnanga o Turanganui a Kiwa, Gisborne, New Zealand.
- Ruru, J. 2009a. *The legal voice of Māori in freshwater governance: a literature review*. Landcare Research, Lincoln, New Zealand.
- Ruru, J. 2009b. Undefined and unresolved: exploring indigenous rights in Aotearoa New Zealand's freshwater legal regime. *Journal of Water Law* 20(5/6):36-242.
- Ruru, J. 2009c. *The common law doctrine of native title possibilities for freshwater*. Paper presented at the Indigenous Legal Water Forum. Indigenous Legal Water Forum, Dunedin, New Zealand.
- Ruru, J. 2009d. Indigenous peoples and freshwater: rights to govern? *Resource Management Journal* 10-13.
- Ruru, J. 2011a. Māori legal rights to water: ownership, management, or just consultation? *Resource Management Theory and Practice* 7:119-135.
- Ruru, J. 2011b. Property rights and Māori: right to own a river? Pages 51-76 in K. Bosselmann and V. Tava, editors. *Water rights and sustainability*. New Zealand Centre for Environmental Law Monograph Series. Volume 3. New Zealand Centre for Environmental Law, Auckland, New Zealand.
- Ruru, J. 2012. The right to water as the right to identity: legal struggles of indigenous peoples of Aotearoa New Zealand. Pages 110-122 in F. Sultana and A. Loftus editors, *The right to water: politics, governance and social struggles*. Earthscan, Abingdon, UK.
- Sinner, J., and G. R. Harmsworth. 2015. *Māori involvement in collaborative freshwater planning—insights from Hawke's Bay*. Policy brief. Freshwater Values, Monitoring and Outcomes (VMO) programme. MBIE contract: C09X1003. Landcare Research, Lincoln, New Zealand.
- Stewart, M., G. Tipa, E. Williams, M. Home, G. Olsen, and C. Hickey. 2014. *Impacts of bioaccumulative contaminants in the Te Waihora Catchment on Mahinga Kai gatherers: data report and risk assessment*. NIWA Client Report HAM2014-012 for Te Waihora Management Board and Environment Canterbury Regional Council. Te Waihora Management Board and Environment Canterbury Regional Council, Christchurch, New Zealand.
- Tan, P., and S. Jackson. 2013. Impossible dreaming: does Australia's water law and policy fulfil Indigenous aspirations? *Environmental & Planning Law Journal* 30:132.
- Taranaki District Council (TDC). 2007. *A cultural health index for Reservoir Creek. Indicators for recognising and expressing Tangata Whenua ki Whakatu values*. TDC, Stratford, New Zealand.
- Te Aho, L. 2010. Indigenous challenges to enhance freshwater governance and management in Aotearoa New Zealand—the Waikato river settlement. *Journal of Water Law* 20(5):85-292. [online] URL: https://www.boprc.govt.nz/media/212783/te_aho_1_indigenous_challenges_to_enhance_freshwater_governance_management.pdf
- Te Ao Marama Incorporated and Waikawa Whānau. 2010. *Waikawa Kanakana Research 2009 : monitoring observations and*

recommendations for future monitoring and research. Report for Te Putea Whakakaha Mahika Kai. Te Ao Marama, Invercargill, New Zealand.

Te Arawa Lakes Trust (TALT). 2015. *Te arawa cultural values framework: te tuapapa o ngā wai o Te Arawa*. TALT, Rotorua New Zealand.

Te Rūnanga o Ngāi Tahu (TRONT). 2003. *Ki Uta ki Ta—Mountains to the Sea natural resource management: a scoping document for developing Mountains to the Sea natural resource management tools for Ngai Tahu*. A draft (April 2003) prepared by Kaupapa Taiao for ngā Papatipu Runanga. TRONT, Christchurch, New Zealand.

Te Rūnanga o Ngāi Tahu (TRONT). 2007. Te Waipounamu freshwater report 2007: cultural health assessment of South Island waterways. In C. Pauling, editor. *State of the Takiwa: Ngā Wai Pounamau*. TRONT, Christchurch, New Zealand.

Te Rūnanga o Ngāi Tahu (TRONT). 2013. *Ngā Matapono Ki Te Wai*. Ngāi Tahu, Christchurch, New Zealand. [online] URL: <http://ngaitahu.iwi.nz/wp-content/uploads/2013/06/Nga-Matapono-ki-te-Wai.pdf>

Te Wai Māori. 2008. *Discussion on freshwater: a Wai Māori perspective*. Te Wai Māori Trust, Wellington, New Zealand. [online] URL: <http://waimaori.maori.nz/documents/publications/Freshwater%20-%20Summary.pdf>

Tipa & Associates. 2013. *Cultural values, flow and water management issues for the Waikirikiri/Selwyn-Te Waihora catchments*. Data collected by the Taumutu/Tuahuriri COMAR Team and Horomaka COMAR Team. Report prepared by Tipa & Associates. Environment Canterbury Regional Council, Christchurch, New Zealand. [online] URL: <http://files.ecan.govt.nz/public/lwrp/variation1/cultural-values-flow-water-management-issues-waikirikiri-selwyn-te-waihora-catchments.pdf>

Tipa, G. 1999. *Māori environmental indicators: Taieri River case study*. Technical paper No. 58. Ministry for the Environment, Wellington, New Zealand.

Tipa, G. 2009. Exploring indigenous understandings of river dynamics and river flows: a case from New Zealand. *Environmental Communication* 3:95-120. <http://dx.doi.org/10.1080/17524030802707818>

Tipa, G. 2010. Consideration of a significance assessment method for tangata whenua river values. Pages 1-36 in K. F. D. Hughey and A. J. M. Baker, editors. *The river values assessment system, volume 2: application to cultural, production and environmental values*. LEaP Report No. 24B. Lincoln University, Christchurch, New Zealand. [online] URL: <http://www.lincoln.ac.nz/Documents/LEaP/Chap-8-Tangata-whenua-Southland.pdf>

Tipa, G. 2012. Environmental flow assessments: a participatory process enabling Māori cultural values to inform flow regime setting. Pages 467-491 in B. R. Johnston, L. Hiwasaki, I. J. Klaver, A. R. Castillo, and V. Strang, editors. *Water, cultural diversity and global environmental change: emerging trends, sustainable futures?* Springer, Dordrecht, Netherlands. http://dx.doi.org/10.1007/978-94-007-1774-9_32

Tipa, G., and K. Nelson. 2012. Identifying cultural flow preferences: Kakaunui River case study. *Journal of Water Resources Planning and Management* 138:660-670. [http://dx.doi.org/10.1061/\(ASCE\)WR.1943-5452.0000211](http://dx.doi.org/10.1061/(ASCE)WR.1943-5452.0000211)

Tipa, G., and C. Severne. 2010. *Including Mātauranga Māori in environmental flow setting decisions*. NIWA Report HAM 2010-030 for the Ministry for the Environment. National Institute of Water and Atmospheric Research, Wellington, New Zealand.

Tipa, G., and L. Teirney. 2003. *A cultural health index for streams and waterways: indicators for recognising and expressing Māori values*. Ministry for the Environment, Wellington, New Zealand.

Tipa, G., and L. Teirney. 2006a. *Using the Cultural Health Index: how to assess the health of streams and waterways*. Ministry for Environment, Wellington, New Zealand. [online] URL: <http://www.mfe.govt.nz/publications/cultural-health-index-streams-and-waterways-feb06>

Tipa, G., and L. Teirney. 2006b. *A Cultural Health Index for streams and waterways: a tool for nationwide use*. Final technical report ME701. Ministry for the Environment, Wellington, New Zealand. [online] URL: <http://www.mfe.govt.nz/publications/cultural-health-index-streams-and-waterways-tech-report-apr06>

Tipa, G. T. 2013. Bringing the past into our future—using historic data to inform contemporary freshwater management. *Kotuitui: New Zealand Journal of Social Sciences* 8:40-63. <http://dx.doi.org/10.1080/1177083x.2013.837080>

Townsend C. R., G. Tipa, L. D. Teirney, and D. K. Niyogi. 2004. Development of a tool to facilitate participation of Māori in the management of stream and river health. *EcoHealth* 1(2):184-195. <http://dx.doi.org/10.1007/s10393-004-0006-9>

Velasquez Runk, J. 2014. Enriching indigenous knowledge scholarship via collaborative methodologies: beyond the high tide's few hours. *Ecology and Society* 19(4):37. <http://dx.doi.org/10.5751/ES-06773-190437>

von der Porten, S., and R. C. de Loë. 2013a. Collaborative approaches to governance for water and Indigenous peoples: a case study for British Columbia, Canada. *Geoforum* 50:149-160. <http://dx.doi.org/10.1016/j.geoforum.2013.09.001>

von der Porten, S., and R. C. de Loë. 2013b. Water governance and Indigenous governance: towards a synthesis. *Indigenous Policy Journal* XXIII(4):1-12.

von der Porten, S., and R. C. De Loë. 2014. Water policy reform and Indigenous governance. *Water Policy* 16(2):222-243. <http://dx.doi.org/10.2166/wp.2013.046>

Waikato River Authority. 2011. *Restoring and protecting the health and wellbeing of the Waikato River. Vision and strategy for the Waikato River*. Waikato River Authority, Hamilton, New Zealand. [online] URL: <http://www.waikatoriver.org.nz/wp-content/uploads/2011/07/Vision-and-Strategy.pdf>

Waitangi Tribunal. 2010. *Waikato Raupatu Claims (Waikato River) Settlement 2010*. Parliamentary Counsel Office, Wellington, New Zealand. [online] URL: http://www.legislation.govt.nz/act/public/2010/0024/latest/DLM1630105.html?search=sw_096be8ed80e3448a.Statement+Significance_25_se&p=1&sr=3

Waitangi Tribunal. 2011. *Ko Aotearoa Tenei: Te Taumata Tuatahi—a report into claims concerning New Zealand law and policy affecting Māori culture and identity*. Brooker & Friend, Wellington, New Zealand.

Williamson, B., J. Quinn, E. Williams, and C. Van Schravendijk-Goodman. 2016. *2016 Pilot Waikato River report card: methods and technical summary*. Report prepared for the Waikato River Authority. Waikato River Authority, Hamilton, New Zealand.

Waikato Tainui. 2015a. Waikato-Tainui fisheries bylaws a step closer to river restoration. Waikato Tainui, Hamilton, New Zealand. [online] URL: <http://www.waikatotainui.com/waikato-tainui-fisheries-bylaws-a-step-closer-to-river-restoration/>

Waikato Tainui. 2015b. Waikato-Tainui fisheries area bylaws. Waikato Tainui, Hamilton, New Zealand. [online] URL: <http://www.fish.govt.nz/en-nz/Maori/Waikato-Tainui+Fisheries+Area+Bylaws.htm>

Walker D. P. 2009. *Iwi estuarine indicators for Nelson*. Prepared for Nelson City Council. Tiakina te Taiao occasional report. FRST Envirolink report 628-NLCC 31 ID 628. [online] URL: <http://www.envirolink.govt.nz/PageFiles/425/628-nlcc31.pdf>

Williams, E., J. Boubée, J. Jameson, P. Horton, J. Potangaroa, C. Baker, M. Stewart, A. Zernack, and S. Crow. 2014. *Glass eel recruitment, species separation trials and juvenile eel surveys. Rangitaane tuna aquaculture—year 1 review of activities*. NIWA Client Report WLG2014-83. Prepared for Te Ohiu Tiaki o Rangitaane Te Ika a Maui Trust. National Institute of Water and Atmospheric Research, Wellington, New Zealand.

Young, R., G. Harmsworth, D. Walker, and T. James. 2008. *Linkages between cultural and scientific indicators of river and stream health*. Motueka Integrated Catchment Management (Motueka ICM) Programme Report. Prepared for Stakeholders of the Motueka Integrated Catchment Management Programme. Landcare Research, Lincoln, New Zealand. [online] URL: http://icm.landcareresearch.co.nz/knowledgebase/publications/public/Cultural_indicators_report2.pdf

Appendix 1. Glossary of terms.

Local government – includes territorial local authorities, unitary authorities, and regional councils that carry out functions and administration regionally for the New Zealand Government.

Regional Councils – local government bodies responsible to carry out Crown or Government legislation particularly centred on resource management, local planning and policy.

The Crown – The Crown in New Zealand represents the constitutional system of government, the executive that governs, forming a Westminster-style parliamentary democracy where legislative or judicial branches of the New Zealand Government write and pass national legislation and policy.

The Treaty of Waitangi (TTOW/Te Tiriti o Waitangi) – A written agreement (in Māori and English) signed in 1840 between the British Crown (now the New Zealand Government) and iwi/hapū tribal groups in New Zealand. TTOW established a partnership for British sovereignty and recognition of indigenous rights and governance. There are 4 main articles in TTOW: 1) sovereignty, kawanatanga, British authority to govern; 2) The Crown guarantees "full, exclusive and undisturbed possession of indigenous peoples lands and estates, forests, fisheries and other properties" and indigenous Māori have tino rangatiratanga (tribal authority) over all taonga; 3) the Queen gives protection to "all the ordinary people living in New Zealand"; 4) the Māori text includes rights to practice religious freedom and customary lore.

Waitangi Tribunal – Established in 1975, the Waitangi Tribunal is charged with making recommendations on Treaty claims to Government (The Crown), that seek redress and settlement by Māori relating to historic actions, grievances, and omissions by the Crown that breach the 1840 Treaty.

Principles of the Treaty of Waitangi – 5 main principles based on the Treaty are described:

1. Principle of Government (Kawanatanga principle): The British Government to govern for the common good (article 1 sovereignty, and 'interests' 2).
2. Principle of self-management (rangatiratanga principle): iwi rights to manage resources, taonga, iwi affairs, etc. articles 2 & 3 of the Treaty of Waitangi.
3. Equality: all NZers equal under NZ laws article, reduces disparities in society.
4. Principle of reasonable cooperation: government and iwi are obliged to accord each other cooperation on major issues of concern (good faith).
5. Principle of redress: the government was responsible for providing effective processes for the resolution of grievances in the expectation that reconciliation could occur.

Ngā Kupu Māori – Māori words

Hapū – local sub-tribes that make up larger iwi groupings, at local or district geographic level

Harakeke – flax, important customary plant and fibre for weaving (*Phormium tenax*)

Inanga – juveniles of native fish, 5 *galaxiid* species, commonly called whitebait (*Galaxias maculatus*)

Iwi – a Māori tribe, often in a geographic area, at regional or district level

Kaitiaki – person or agent giving benefit to the resource, environmental guardian

Kaitiakitanga – environmental guardianship, embodies a range of complex Māori environmental concepts

Kanakana/piharau – Lamprey fish (*Geotria australis*)

Kaupapa – Framework, philosophy, purpose, scope, topic, sets cultural framework for discussion

Kōkopu – native *galaxiid* species (banded kōkopu – *Galaxias fasciatus*; shortjaw kōkopu – *Galaxias postvectis*, and giant kōkopu – *Galaxias argenteus*)

Koaro – native fish (*Galaxias brevipinnis*)

Koura – freshwater crayfish (*Paranephrops planifrons*, *Paranephrops zealandicus*)

Kuta – important customary plant for weaving (*Eleocharis sphacelata*)

Mātauranga Māori – Māori knowledge, Māori knowledge system, belief system, wisdom

Mahinga kai – places where customary resources (e.g., plants, fish, food) are harvested or collected

Mauri – life force, internal spirit or wairua, energy of system, links the physical to the spiritual world

Ngā Mātāpono – our values

Raupō - important customary plant for weaving (*Typha orientalis*)

Rūnanga – tribal/governing council, Māori assembly, iwi authority

Takiwā – tribal region/area or province

Tangata whenua – local people, people of the land, people inextricably linked to their natural resources

Taonga – treasured/precious resources such as the language, customs, flora and fauna species, iconic species, indigenous or customary species

Te Ao Māori – Māori world, Māori world view

Wairua – spiritual dimension

Whānau – family, extended family; groups make up hapū and iwi

Whakapapa – ancestral lineage, hierarchical assemblage of descendants, inter-connections

Wai – water, freshwater ecosystems

Whenua – land, placenta