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A geomorphic perspective on the rights of the river in Aotearoa New Zealand

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Abstract

The granting of rights to the Whanganui River in 2017 emerged as an outcome of Tribunal hearings relating to breaches of the Treaty of Waitangi, signed between Māori chiefs and the British Crown in 1840. As this expression of a river as having legal personhood with rights reflects a distinctively Māori perspective upon river systems, it offers the prospect for a new era of sociocultural approaches to river management in Aotearoa New Zealand. Using the Whanganui River as a case study, this paper explores prospective geomorphic meanings of river rights. The paper asks, "What role can geomorphology play in identifying, articulating and protecting the rights of a river?" Ancestral Māori relations to the river based upon mutual codependence (reciprocity) are juxtaposed against geomorphic understandings of a river's agency as expressed through self-adjustment, diversity of form, evolution, and catchment-scale connectivities. Relations between river science and indigenous concepts of rivers, framed under the auspices of river rights, present opportunities for different approaches to river management.

KEYWORDS

geomorphology, mātauranga Māori, river health, river management, river rights

1 | INTRODUCTION

In March 2017, the Whanganui River on the North Island of Aotearoa New Zealand was granted the status of legal personhood. A new legal entity was created, *Te Awa Tupua*, referring to "an indivisible and living whole from the mountains to the sea, incorporating the Whanganui River and all of its physical and metaphysical elements" (*Te Awa Tupua* [Whanganui River Claims Settlement] Act, section 13(b)). This law conferred *Te Awa Tupua* "all the rights, powers, duties, and liabilities of a legal person" (section 14(1)), to be expressed through a newly created governance authority. Although the idea of treating a river as a legal person is novel in Aotearoa New Zealand, it joins an international chorus of legal and constitutional developments that assert the "rights of nature," including initiatives in Bolivia, India, and Ecuador, along with Te Urewera (the ancestral territory of Tūhoe kin groups) in Aotearoa New Zealand, among others (e.g., Boyd, 2017; O'Donnell & Talbot-Jones, 2018). Legal personhood for rivers raises a range of scientific, ethical, and institutional questions: What rights might a river have, how should they be understood, and how can they be put into practice? Such concerns epitomize many productive encounters in the "cross-over" spaces where indigenous knowledges and scientific discourses intersect (e.g., Fox et al., 2017; Thomas, 2015; Wilcock, Brierley, & Howitt, 2013; Yates, Harris, & Wilson, 2017).

This paper explores what role geomorphologists might play in identifying, articulating, and protecting the rights of a river in Aotearoa New Zealand and more broadly. Because the legal personhood of the Whanganui River and its rights are inspired by ancestral Māori perspectives, we first consider what these rights might emphasize and include. Then, we review scientific foundations in fluvial geomorphology to offer seven prospective "geomorphic rights" that may be congruent with Māori ideas about rivers as living beings, considering how these scientific framings align with the Te Awa Tupua Act. We argue that while geomorphology already has much to offer in thinking about a river's rights, geomorphologists also have much to learn—or

perhaps unlearn—with regard to recognizing and understanding diverse ways of knowing and relating to rivers. In the context of river rights, this prompts careful consideration of the value bases that underpin governance frameworks and the ways in which geomorphic knowledge is produced and applied.

2 | A MĀTAURANGA MĀORI PERSPECTIVE ON RIVER RIGHTS

In *Te Ao Māori* (the Māori world), people are simply one element in the relational networks known as *whakapapa*, linked with all other life forms through their shared descent from earth and sky (Salmond, 2014). Humans exist in a kinship-based relationship with *Te Taiao*—the earth, universe, and everything within it (Hikuroa, 2017). *Whakapapa* is the central principle that orders *Te Taiao* (the everyday world). In this relational schema, ancestors are literally planted in the earth. For this reason, they are known as *tangata whenua* (people of the land). As noted by Te Aho (2010, p. 285), "We see ourselves as direct descendants of our earth mother and sky father and consequently not only 'of the land' but 'as the land'." People, sky, rivers, and ancestors overlap in Māori language (Salmond, 2014): Rivers are the tears of Ranginui (the sky ancestor), fish are the offspring of Tangaroa (the ancestor of water creatures), and *taniwha* are water guardians. Identification with the landscape is recognized in terms of *pepeha* (tribal sayings that cite mountains, rivers, lakes such as *Ko Ruapehu te maunga*, *ko Whanganui* [*Te Awa Tupua*] *te awa*—Ruapehu is the mountain, Whanganui is the river), exemplified by questions posed at first meeting *No wai koe*? "Of what waters are you?" (Morgan, 2006) or *Na wai koe*? "Of whose waters are you?" Rivers are inextricably tied to identity over time, as iwi (tribes) or hapū (family-groupings) developed distinctive relationships with their ancestral waters and associated *taonga* (treasures).

Māori relational thinking might be understood to appreciate rivers as complex and emergent networks of plants, animals, land, water, and people in a dynamic process of coevolution (Salmond, 2017). As the new legal entity *Te Awa Tupua* describes, these living systems are fashioned by the coevolution and interdependence of interwoven biotic, abiotic, and social dimensions. For Māori, an *awa* is not just a river but an interconnected, living being that cannot simply be understood as a collection of measurable or definable parts. As described by Te Aho (2010, p. 287),

> *Through Māori eyes, rivers are generally seen as whole and indivisible entities, not separated into beds, banks and waters, nor into tidal and non-tidal, navigable and non-navigable parts. Through creation beliefs, the river is a living being, an ancestor with its own life force, authority and prestige, and sacredness.*

This positions a river as not just a resource to be used or a hazard to be controlled, but as an ancestral force to be lived with, reckoned with and respected. This is reflected in several common Māori sayings, for instance, *Ko au te awa*, *ko te awa ko au* ("I am the river, the river is me"), "Harm the river and you harm my ancestors," "Take care of the land, and the land will take care of you." This reciprocal relationship entwines *manaaki whenua* (caring for the land) and *manaaki tangata* (caring for people; Harmsworth, Awatere, & Robb, 2016). Custodial linkages are expressed through *kaitiakitanga* (guardianship), with deep respect for ancestral linkages that position people as part of landscapes and ecosystems (Marsden, 2003). As noted by Knight (2016, p. 29),

> *The interactions of* tangata whenua *with the* awa *over which they exercised* mana *(authority) were guided by the need to preserve and maintain its* mauri*—to protect both the health of the river itself and the wellbeing of the people who depended on its resources.*

Remarkable transformations in societal relationships with the land, rivers, and Māori have occurred since the first arrival of Europeans in Aotearoa New Zealand. For settlers, the value of rivers was measured mainly by their utility. Nature was something to be exploited, almost without limit, and rivers were no exception (Knight, 2016). New ideas of ownership and property fragmented the land through individualized and privatized land titles. Land could not be "owned" unless it was productively "worked" (Salmond, 2014, 2017). Notions of progress and improvement brought about the wholesale clearance of native vegetation, the drainage of wetlands, and the creation of large grassland areas for pastoral farming. Rivers were treated as drains or sewers, conduits for the disposal of waste with a seemingly limitless capacity for self-cleansing and self-renewal (Knight, 2016). Impacts on rivers from mining, forestry, sawmilling, pastoral farming, flax milling and the operation of tanneries, dairy factories, and meat works were accentuated in the 20th century by the implementation of a "command and control" management ethos. Major hydroelectricity schemes, irrigation projects, and artificial stopbanks (levees) transformed virtually all alluvial rivers in the country (Young, 2013; Young & Foster, 1986). Civil engineers were tasked with harnessing the powers of nature for human benefit, straightening, diverting, and culverting rivers to separate them from people (Knight, 2016). Catastrophic biodiversity losses ensued. Channels and harbours filled with sediment, pollutants and contaminants, and aquifers and waterways were depleted beyond sustainable limits.

Te Tiriti o Waitangi (The Treaty of Waitangi), signed in 1840 between the British Crown (now represented by the New Zealand Government) and the leaders of indigenous Māori iwi/hapū tribal groups, established a collaborative partnership that crosses jurisdictions, agencies, and communities to recognize and acknowledge indigenous rights. It conferred responsibilities and obligations on subsequent New Zealand governments to uphold the rights of Māori as British subjects and New Zealand citizens, while protecting their land, estates, water, forests, and other resources or treasures (*taonga*; Harmsworth et al., 2016). The Treaty has been the subject of heated debate since 1840, with various interpretations of its meanings both in Māori and in English (see Salmond, 2014). The Waitangi Tribunal was formed in 1975 to redress grievances and breaches of the Treaty. It has investigated many complaints by Māori kin groups, including claims relating to the loss and degradation of ancestral rivers, lakes, springs, wetlands, estuaries, and other waterways. Recommendations and settlements that have resulted from Tribunal processes have included formal apologies, as well as economic and cultural reparation (Ruru, 2009). The Tribunal has articulated a number of resource-

specific principles, while stating that the spiritual and cultural significance of a freshwater resource can only be determined by *tangata whenua* and their traditional rights (Harmsworth et al., 2016; Ruru, 2012). These principles, along with other advocacy, have engendered significant Māori reengagement with environmental management policy in Aotearoa New Zealand. The emergence of the Whanganui River as a legal entity, with its own rights, arose out of court proceedings associated with the Waitangi Tribunal.

Incorporation of mātauranga Māori (Māori knowledge) in approaches to the management and monitoring of water and aquatic ecosystems seeks to maintain and/or enhance the health and *mauri* (life force) of the waterways themselves, their associated ecosystems, and the people who associate with them. Indeed, *Te Mana o te Wai*—the integrated and holistic well-being of a freshwater body—is a key component of the National Policy Statement on Freshwater Management (2014). Working with the life force, the *mauri* of the river, entails protecting (or enhancing) the *mana* (authority) of the river itself. Notions of *ora* (health, well-being) encapsulate a state of peace, prosperity, and well-being for people, plants, and animals, as well as the river. *Ora* is not simply a biophysical or even socioecological concept; it also has philosophical (ontological) and political dimensions. Its contrary, *mate*, refers to a state of ill-health or dysfunction, as a result of faltering or failing interdependencies within a system. Such conceptualizations of rivers as living beings that include land, water, plants, animals, and people see people as part of a relational network, without arrogance or assumptions that they are in control of it (Salmond, 2017). What constitutes a state of *ora*, and what it will take to look after it, reflects catchment-specific attributes, values, relationships, dynamics, evolutionary traits, and emergent properties.

3 | GEOMORPHOLOGY AND RIVER RIGHTS

In his conceptualization of river systems, Davis (1906) likened river networks to veins on a leaf, emphasizing the importance of a catchment perspective that links hillslopes to valley floors—the land to the river. Such thinking prompted Chorley (1969) to refer to the catchment as the fundamental geomorphic unit, wherein each river operates an interconnected pattern of reaches, with differing balances of erosional and depositional processes in source, transfer, and accumulation zones (Montgomery, 1999; Schumm, 1977). Fluvial geomorphologists have dedicated enormous effort to understanding sediment movement, river diversity, behavioural regime, patterns/rates of adjustment, evolution, and connectivity at reach and catchment scales. These efforts have achieved general consensus on the broad controls on river forms and dynamics from bedrock-controlled (i.e., forced) to fully self-adjusting (i.e., alluvial) variants as the products of slope, discharge, sediment calibre/amount, and resistance elements on the valley floor (e.g., Eaton & Millar, 2017; Nanson & Huang, 2017; see also Kasprak et al., 2016). In geomorphic terms, alluvial river reaches shape their own forms, rates, and pathways of adjustment, consuming their own energy as they convey the flow and sediment that is made available to them. The river decides how many channels it will have (if any), the size and shape of these channels, their alignment (sinuosity), and forms/rates of adjustment on the valley floor (e.g. thalweg shift, lateral migration, cut-off formation, or avulsion). In turn, the distribution of flow energy determines the position and extent of erosional and depositional processes, and the resulting pattern of resistance elements, as flow-sediment interactions determine the pattern of bed material sizes in channel and floodplain compartments. Mutual interactions with riparian vegetation and instream wood, and hyporheic zone processes, influence these spatial and temporal morphodynamics, collectively shaping the dynamic physical habitat mosaic of alluvial reaches. Hence, geomorphic analyses of riverscapes provide an integrative template to assess hydromorphic and ecological associations (e.g., Wiens, 2002).

Geomorphologists have also given significant consideration to appraisal of river condition, assessing the morphodynamics of a given reach relative to either reference conditions or an "expected range of variability" in efforts to compare like with like (e.g., Fryirs, 2015; see Blue & Brierley, 2016). For example, habitat heterogeneity, connectivity, and patterns of erosion vary markedly for a laterally adjusting meandering river relative to a gorge or a swamp (e.g., Fryirs & Brierley, 2009). Appropriate measures of river health also incorporate socially desirable criteria, moving beyond notions of "pristine" reference conditions based solely upon "natural" values (Blue, 2018; Dufour & Piégay, 2009). Recent research in applied fluvial geomorphology emphasizes the need to live with variability, complexity, and uncertainty as part of resilience-based management practices, recognizing that process interactions in river systems are dependent on local histories of adjustment (e.g., Brierley et al., 2013; Parsons & Thoms, 2017). These assertions emphasize the imperative to respect diversity and variability, rather than seeking to "make rivers the same" (Tadaki, Brierley, & Cullum, 2014). These various threads inform emerging approaches to river management practice that "work with nature," framing analyses of reach-scale morphodynamics in their catchment context and working with the evolutionary trajectory of the river (Brierley & Fryirs, 2005, 2016; WWAP, 2018).

In various parts of the world, "room/space to move" or "freedom space" initiatives have been adopted as a more sustainable approach to living with (rather than managing) rivers (e.g., Biron et al., 2014; Buffin-Bélanger et al., 2015; Piégay, Darby, Mosselman, & Surian, 2005). These programmes seek to support the shifting habitat mosaic of river systems, creating a balance between the environmental benefits derived from allowing the river to flow freely and self-adjust within the river corridor, while maximizing public security and economic benefits from protecting property and infrastructure outside of the river corridor. Such multi-purpose initiatives help to address concerns for a range of biophysical, economic, cultural, recreational, and aesthetic values. Delaying the conveyance and reducing the peak of the flood pulse, while enhancing the capacity of the system to "self-heal" (Kondolf, 2011), helps to support flood and erosion/sedimentation management programmes, aiding protection of infrastructure and reducing maintenance costs. It also creates greater "buffering capacity" in planning and managing for uncertain futures. Prospectively, these various socio-economic, cultural, and biophysical attributes can be used to support the geomorphic "right" of an alluvial river to self-adjust.

In summary, several interconnected threads can be conceived as part of a geomorphic perspective on the "rights" of a river:

1. A right to flowing water, and associated spatial and temporal variability in hydrologic and hydraulic regime.
2. A right to convey sediment, adjusting the balance of erosional and depositional processes in any given reach, and how these reaches fit together at the catchment scale, as materials are transported from "source to sink."
3. A right to be diverse, reflecting geographic and historical controls upon the inherent geodiversity (i.e., heterogeneity and/or homogeneity) of a river reach.
4. A right to adjust, shaped by mutual interactions between flow, sediment, riparian vegetation, wood, ecosystem engineers, and groundwater that set the dynamic habitat mosaic of river systems.
5. A right to evolve, set by responses to disturbance events and changes to boundary conditions that influence the trajectory of geomorphic adjustment of a river.
6. A right to operate at the catchment scale, as connectivity relations determine how changes to one part of a river system impact elsewhere in the catchment, and at the coastal interface, over what timeframe.
7. A right to be healthy, operating as a living river that maintains its integrity, vigour, and vitality, maximizing its resilience to impacts of disturbance.

In light of these principles, geomorphology can make a considerable contribution to understanding the rights of the river. Prospectively, such scientific insights can be productively framed alongside *Te Ao Māori* based on an in-depth understanding of local mātauranga Māori.

4 | CASE STUDY: A GEOMORPHIC PERSPECTIVE ON THE RIGHTS OF THE WHANGANUI RIVER

> *If I am the river and the river is me—then emphatically I am dying.*
> *A Māori elder, Turama Thomas Hawira, lamenting at the Waitangi hearings for the Whanganui River (quoted in Salmond, 2014, p. 294)*

> *The river and the land and its people are inseparable. And so if one is affected the other is affected also. The river is the heartbeat, the pulse of our people. … [If the river] dies, we die as a people. Ka mate te Awa, ka mate tātou te Iwi.*
> *Niko Tangaroa, Māori elder, Whanganui Iwi (sourced from Kennedy, 2012)*

4.1 | Te Awa Tupua (Whanganui River Claims Settlement) Act 2017

What might geomorphologically informed "rights" look like for the Whanganui River, the longest navigable river in Aotearoa New Zealand (around 140 km)? The river flows from the volcanic central plateau of the North Island to the west coast. In a relatively rare circumstance for a moderately large river system in Aotearoa New Zealand, the entire length of the Whanganui is held by a number of hapū (subtribes) with a single common ancestor, Te Āti Haunui-a-Pāpārangi. The unity and connection between these hapū is emphasized by sayings such as *te taura whiri a Hinengākau* (the plaited rope of Hinengākau), referring to one of the three children of the Te Āti Haunui-a-Pāpārangi chief Tamakehu (Knight, 2016). Hinengākau settled on the upper river, whereas Tama Upoko settled in the middle reaches and Tupoho on the lower reaches of the river. Each strand of the *whakapapa* intertwines with the others, just as currents entangle in the river. Their names are regularly invoked to express the basic unity of *Te Āti Haunui* as a "river people," for whom their settlements and social and economic activities were focused almost exclusively on the river:

> *… the river was central to Atihaunui lives, their source of food, their single highway, their spiritual mentor. (Waitangi Tribunal, 1999, pxiii)*

In 1891, the scenery of the Whanganui River became the only river in New Zealand to be protected by law. In practice, however, the Whanganui River Trust Act sought to preserve and "improve" the river for navigation, asserting values of a culturally desirable landscape from a European perspective (Knight, 2016, p 64). Although water diversion schemes are anathema to Māori values, the development of the Tongariro Power Scheme in the headwaters of the Waikato River in the 1960s diverted waters from the headwaters of the Whanganui River (see Figure 1). At this time, the government did not recognize the existential entanglement between Whanganui tribes and their ancestral river, their interests in it, and their concerns for its well-being (Šunde, 2008). Whanganui Māori were neither consulted nor given notice about this scheme. The turbulent, glacial-blue flows of the Whakapapa River were reduced to a trickle, transferring 97% of its water. An iwi representative, Gerrard Albert, later described it: "… the head of our river has been cut off, and it no longer exists as a whole river … and so we continue to bleed as a people, as it bleeds as a river" (quoted in Knight, 2016, p. 139).

Throughout a long history of petitions and litigation dating back to the 19th century, *Te Āti Haunui-a-Pāpārangi* have consistently claimed their rights to the Whanganui River (Whanganui River Charter, 1993). The Waitangi Tribunal (1999) accepted a claim affirming that the river was and remains the iwi's *taonga* (ancestral treasure), central to its tribal identity, way of life, and well-being. Associated rights were guaranteed by the Treaty, and iwi had never freely or willingly relinquished their relationship with *Te Awa Tupua*. On August 5, 2014, 15 years after the Tribunal's report was released and 148 years after the claim was first made, the final settlement between the Crown and Āti Haunui was agreed, concluding the longest running legal case in New Zealand history. The deed of settlement was groundbreaking in one key aspect: It made the river, known as *Te Awa Tupua*, a legal person with rights, powers, duties, and liabilities. In March 2017, the *Te Awa Tupua* (Whanganui River Claims Settlement) Act was passed into law, describing the Whanganui River as "an indivisible and living whole, comprising the Whanganui River from the mountains to the sea, incorporating all its physical and metaphysical elements." In this Act, *Tupua te Kawa*, the Whanganui River is described as the source

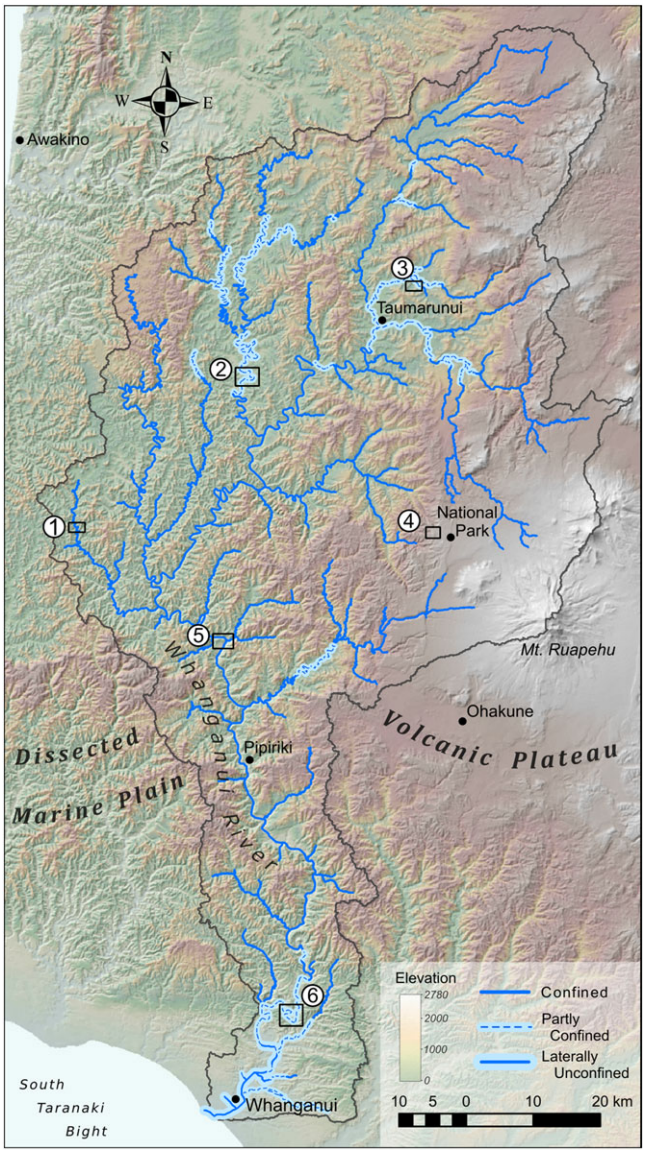

FIGURE 1 Map showing the pattern of valley confinement along fourth and higher order streams of the Whanganui River, North Island, New Zealand. Valley confinement determinations are based on procedures outlined in Fryirs, Wheaton, and Brierley (2016). Numbers 1–6 refer to study sites used as examples of river diversity in the Whanganui Catchment in Figure 2 [Colour figure can be viewed at wileyonlinelibrary.com]

of *ora* (life, health, and well-being), a living whole that runs from the mountains to the sea, made up of many tributaries and binding its people together. Sayings often used by Whanganui people, such as *Ko au te Awa, ko te Awa ko au* (I am the River, the River is me), reflect a reciprocal existential merging, as well as a commitment to associated rights and obligations (Salmond, 2017, 2018).

In some ways, designating a river as a "living being" in common law is a revolutionary step. By recognizing the river, *Te Awa Tupua* (literally, river with ancestral power), as a legal entity with an "independent voice," the Whanganui River was placed in a new set of relationships with human beings (Salmond, 2014). The river's own needs and rights were given legal protection. On the other hand, the draft agreement was less radical than it first seemed. A paradox lay at its heart. Although *Te Awa Tupua* Act declares the Whanganui River to be a legal person, this only roughly approximates ancestral realities. A *tupua* is not a person but a powerful being from the dark, ancestral realm, and an *awa* (river) is not an individual, but a living community of fish, plants, people, ancestors, and water, linked by *whakapapa*. In some ways, making the Whanganui a legal person with its own rights is a modernist device that asserts "property rights" and "resource consents." Other than the statements of intrinsic value in Māori in the Act, an underlying premise that Man is separated from and controls Nature is not challenged (Salmond, 2017).

In expressing and articulating the legal rights of the river as akin to the legal rights of a person, a unique governance arrangement was established in which two guardians have been appointed, one proposed by local kin groups and one proposed by the Crown. In combination, they act as *Te Pou Tupua*, "the human (living) face" of the river, acting in its name and in its interests (i.e., protecting its rights) and administering *Te Korotete* (literally, a storage basket for food from the river; Salmond, 2014). These two individuals are supported by *Te Kopuka* (literally, white mānuka, the timber from which eel weirs across the river were built), a group representing people with interests in *Te Awa Tupua*, and *Te Heke Ngahuru* (literally, the autumn migration of eels; Salmond, 2014). This strategy brings these people together to advance the environmental, social, cultural, and economic health and well-being of *Te Awa Tupua*. Under this arrangement, the river was placed in the same legal category as children, or adults who are incapacitated, who require guardians to make decisions for them. In this draft version, the river's "independent voice" was a kind of ventriloquism (Salmond, 2017). Although this is certainly an improvement on the previous state of affairs, for Whanganui Māori, this marked a radical shift from ancestral conceptions, in which earth and sky, mountains and rivers are powerful beings upon whom people depend, and where river *taniwha* act as *kaitiaki* (guardians) for people, not the other way around. In the agreement signed with the Crown, on the other hand, human beings are in charge of the cosmos. It is possible, however, that this inversion has been avoided in the final version of the Whanganui deed of settlement, which describes *Te Pou Tupua* as "the human face" of the river, echoing the Māori idea of *kanohi ora*, a person as a living face of their ancestors. How this works out in practice is yet to be seen (see Salmond, 2018).

Table 1 presents a summary overview of intrinsic values of *Te Awa Tupua*, their relationship to the rights of the river, and implications for a landscape (geomorphic) perspective upon river rights. Local (reach) scale concerns for river diversity and health relate specifically to the type of river under consideration, its physical setting, and the socio-economic, cultural, and political context within which the river operates at the catchment scale. This reflects not only contemporary conditions but also consideration of path dependencies that have been set by historical factors. These considerations, in turn, relate to a geomorphic perspective upon the rights of the Whanganui River outlined in Section 3 of this paper. As maintenance of connectivity relations at the catchment scale can be read into each of the intrinsic values of *Te Awa Tupua* outlined in Table 1, it can be considered to be a fundamental attribute of the rights of the Whanganui River. Geomorphic analyses of landscape connectivity refer to the capacity of a river system to transfer flow and sediment from source to sink. In biophysical terms, steep relief and abundant discharge in these highly

TABLE 1 Relationship between intrinsic values of *Te Awa Tupua*, the rights of the river, and a landscape (geomorphic) perspective upon river rights

Te Awa Tupua intrinsic values	Implications for the rights of the river	Implications for a landscape (geomorphic) perspective on river rights
Ko Te Kawa Tuatahi (a) *Ko te Awa te mātāpuna o te ora*: The River is the source of spiritual and physical sustenance: *Te Awa Tupua* is a spiritual and physical entity that supports and sustains both the life and natural resources within the Whanganui River and the health and well-being of the iwi, hapū, and other communities of the River.	Expression and maintenance of river rights builds upon the imperative to maintain healthy sociocultural relations to the river.	Adoption of an ecosystem approach to river management is required to maintain connectivity relations of innately biophysical-and-cultural landscapes.
Ko Te Kawa Tuarua (b) *E rere kau mai i te Awa nui mai i te Kahui Maunga ki Tangaroa*: The great River flows from the mountains to the sea: *Te Awa Tupua* is an indivisible and living whole from the mountains to the sea, incorporating the Whanganui River and all of its physical and metaphysical elements.	River rights are expressed at the catchment scale—a whole of system perspective is fundamental.	In efforts to maintain and enhance the Whanganui River as a functional and healthy ecosystem, it is important to reach scale issues in their catchment context, minimizing negative off-site impacts in the development, planning and prioritization of management activities.
Ko Te Kawa Tuatoru (c) *Ko au te Awa, ko te Awa ko au*: I am the River and the River is me. The iwi and hapū of the Whanganui River have an inalienable connection with, and responsibility to, *Te Awa Tupua* and its health and well-being.	Managing for river rights entails managing for the people of the river—these are deeply reciprocal relationships.	Although important in their own right, measures of river health are more than biophysical. Appraisal of the *ora* of the river also appraises cultural metrics of health. This incorporates concern for both reach- and catchment-scale considerations.
Ko Te Kawa Tuawhā (d) *Ngā manga iti, ngā manga nui e honohono kau ana, ka tupu hei Awa Tupua*: the small and large streams that flow into one another form one River: *Te Awa Tupua* is a singular entity comprised of many elements and communities, working collaboratively for the common purpose of the health and well-being of *Te Awa Tupua*.	The rights of the river are manifested across multiple scales, but ultimately threads (connections and relationships) come together at the catchment scale.	Cross-scalar applications are important, respecting river diversity at local, reach and catchment scales.

connected landscapes exert a critical influence upon the prevailing flow and sediment regime, the dynamic physical habitat mosaic of the river, and associated measures of ecosystem functionality.

The Whanganui River bears a very strong geologic imprint. Its headwaters are deeply incised into the volcanic plateau, and midcatchment and lowland reaches are cut into an uplifted marine plain (Figure 1; see Pillans, 1994). Given the confined valley settings, flood flows are deep; at Pipiriki, river stage may rise more than 15 m above base flow conditions (located on Figure 1). The Whanganui River has very few fully alluvial (laterally unconfined) reaches. Exceptions include a short reach at the river mouth (Figure 2(6)) and various lower order tributaries where wetlands have formed along discontinuous watercourses (these are not mapped on Figure 1, but examples are shown in Figure 2(3 and 4)). Given the dominance of confined and partly confined valley settings, the channel has limited capacity to adjust across most of the catchment (see Figure 2(1 and 5)). Flow, sediment, and any nutrients or contaminants are readily conveyed from source to sink (*sensu* Fryirs, Brierley, Preston, & Kasai, 2007). Unlike many other catchments, there are few disruptions to the linkages between the mountains and the sea. In terms of geomorphic relations to river rights outlined in Section 3 of this paper, this is manifested as the rights to flow, the right to convey sediment, and the right to operate at the catchment scale. However, the altered flow regime of the Whakapapa River associated with the transfer of flows to the Tongariro Power Station presents an affront to these rights. As such, it is no coincidence that related discussions were a fundamental part of Waitangi Tribunal deliberations that underpinned the emergence of rights for the Whanganui River.

The perspective upon river rights outlined in Section 3 also refers to the right of a river to be diverse, to adjust and evolve, and to be healthy (i.e., maintain its *ora*, well-being). Across the Whanganui catchment, the capacity for geomorphic river adjustment is most pronounced in reaches that are located within a partly confined valley setting (Fryirs et al., 2016; Figure 2(2 and 3)). In these settings, the channel has some room to adjust, but it abuts valley walls at various points along its course. As large upstream catchment areas generate significant discharge, and given the moderately steep valley floor slopes, stream power is high and erosive flows are common. The geomorphic effectiveness of flood flows, however, is constrained by resistance elements along the valley floor, as riparian vegetation induces significant roughness and bank strength (Eaton & Millar, 2017). As floodplain pockets provide land that is suitable for human settlement and agricultural land use, valley floors have been drained, riparian vegetation cleared, and defences set up to reduce erosion and flooding hazards in these reaches. These activities have enhanced the geomorphic effectiveness of floods. This, in turn, has altered the forms, rate, and extent of geomorphic adjustment, inducing incision and channel expansion and accelerating erosion rates. In addition, many wetland river environments have been drained and straightened to improve prospects for agriculture and stock grazing, leaving few substantial remnants (e.g., Figure 2(4)). Elsewhere in the Whanganui catchment, habitat diversity and the capacity for geomorphic adjustment is far more limited in the confined (gorge) reaches (Figure 2(1 and 5)). These reaches have a limited range of instream geomorphic features. However, local accumulations of coarse-grained sediment make up various riffles, rapids, and chutes that are an important part of the hydraulic

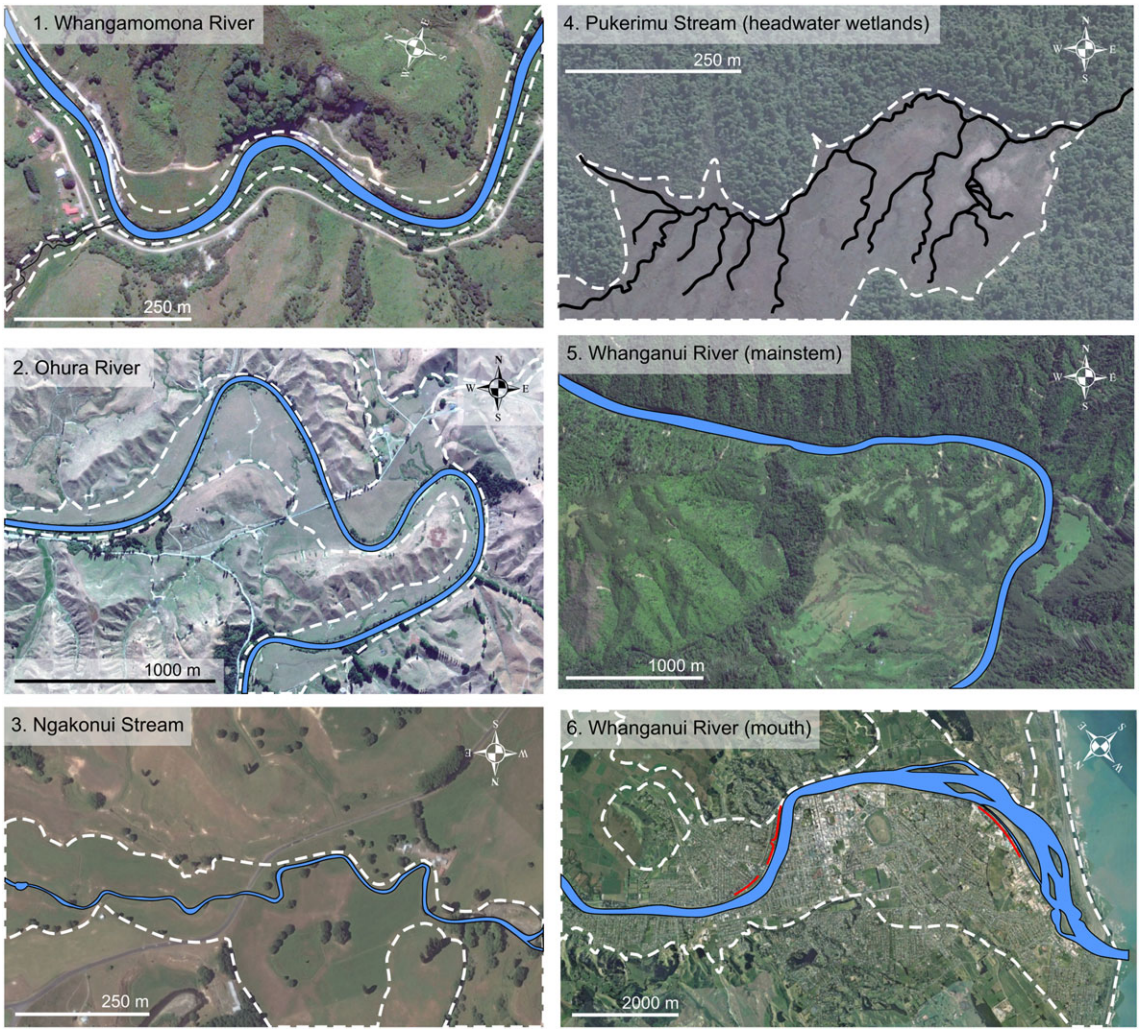

FIGURE 2 Examples of the diversity of river types in the Whanganui catchment (locations are shown on Figure 1). The river course is shown in blue, flowing from left to right in each image. Dashed white lines indicate alluvial surfaces formed by the river. Distinguishing characteristics of each selected reach, and a consideration of geomorphic issues to be addressed in enacting river rights, are summarized in Table 2 [Colour figure can be viewed at wileyonlinelibrary.com]

environment of the river. These materials also provide the tools for further erosion of the canyon bed and walls, enhancing the work of the turbulent waters that have carved deep pools within some sections of the marine bedrock, offering important refugia for eels, fish, and other river dwellers. Finally, in the lower reaches, adjacent to the township of Whanganui, low-lying floodplains are more prominent. Prior to the construction of stopbanks that sought to convey flow downstream more efficiently, the river previously had the capacity to diffuse its energy in this area (Figure 2(6)). The elevated channel bed of the Whanganui River induced by high sediment loads has accentuated flood hazards in low-lying parts of Whanganui city to such a degree that residents along Taupo Quay have recently agreed to surrender their properties and move elsewhere.

These various forms and extents of geomorphic adjustment, in turn, alter the physical habitat mosaic of the river, impacting upon measures of ecosystem functionality and the health of the river (Table 2). Changes to reach-scale morphodynamics also affect the operation of flow and sediment fluxes, impacting upon the lateral and longitudinal connectivity of the river system. For example, flows may be conveyed even more efficiently through larger channels in partly confined reaches, whereas elsewhere in the catchment, the sponge-like filtering effects of wetlands has been diminished. As responses to human disturbance are manifested in different ways and to different degrees for different types of river, with some changes being irreversible over management timeframes of 50–100 years, appropriate measures of river health (*ora*) vary for each river reach (see Brierley & Fryirs, 2005). At the same time, however, *ora* should be appraised at the catchment scale (see Table 1). For example, some aquatic species make use of differing reaches at different parts of their life cycle, and the integrity/vitality of the system as a whole determines their prospects for survival and their capacity to thrive. In geomorphic terms, the rights to be diverse, to adjust, to be healthy, and to evolve are integral components of a living river.

5 | DISCUSSION

In scoping prospects for the rights of the river, there is an implicit assumption that the best available information is used to guide management practices. However, such deliberations are often far from

TABLE 2 Geomorphic attributes of selected reaches of the Whanganui River and an overview of considerations for enacting river rights

Site and river type	Geomorphic attributes	Geomorphic considerations in enacting river rights
1. Confined headwater valley (Whangamomona River)	The channel has incised into valley fill deposits. Bars are infrequent and typically bank-attached, indicating limited capacity for adjustment. A thin riparian margin is evident.	The river requires access to lateral sediment stores in order to replenish gravel supply. River biota require a diversity of instream geomorphic environments (riffles, pools) as well as channel margin (riparian) vegetation. Periodic disturbance from landslides is an essential part of the sedimentary regime. An active bedload regime helps to abrade nuisance algae from the bed and turn over the substrate, enhancing hyporheic flows among the gravels.
2. Partly confined valley with bedrock-controlled floodplain pockets (Ohura River)	The channel hugs the valley margin, occasionally switching from one side of the valley to the other. Significant floodplain pockets store sediment on the inside of bends. Bed incision has disconnected channels from floodplains, which in turn are inset within terraces. Palaeochannels are evident on the floodplain. Riparian vegetation cover is very limited.	Disconnection from floodplains has altered the geomorphic behaviour of this river. Flood flows must access modern floodplains to sequester suspended sediments. Erosion at the base of terraces and steep hillslopes refreshes the bedload supply, helping to maintain channel geometry (width, depth, and slope). Riparian vegetation cover is required to provide additional resistance and bank strength, to shade stream-side habitat, and to supply wood to the channel, thereby enhancing habitat complexity and diversity. Altered geodiversity has likely impacted upon biodiversity values.
3. Partly confined valley with low sinuosity planform-controlled floodplain pockets (Ngakonui Stream)	This incised, low-gradient stream has cut into valley fill deposits. Sections have been straightened and deepened to improve drainage, such that the present low sinuosity channel is essentially inset. Numerous wetlands are evident on the valley floor and form part of discontinuous watercourses along tributaries that feed into this reach.	Drainage and channelization of the wetland has altered the structural and functional integrity of this corridor and connectivity relationships (i.e., flow and sediment regimes). Elements of functionality have been lost, as wetland systems have been transformed. Flows are closely coupled with vegetation in such environments; wetland conditions enable regulation (dampening) of run-off during floods, filtration of sediments, and provision of important nutrients to stream biota.
4. Discontinuous watercourse (Pukerimu Stream)	Tortuous, low capacity channels are discontinuous, occasionally disappearing within the wetland vegetation. This wetland has developed within valley fill deposits. As flow is strongly connected to subsurface water supply, channel expression varies during wet and dry conditions, including seasonal effects.	Wetlands maintain several important regulatory functions for river flows, filtration, and nutrient flux, enhancing river health at local, reach, and catchment scales. Given their distinct geoecological values, they have a high priority for preservation. The river is dependent upon seasonal water balance, and any changes to this will alter the functionality of the river system.
5. Canyon/gorge (Whanganui mainstem)	This is a typical deeply incised section of the Whanganui River. The channel is cut into bedrock (papa rock), with high level marine terraces evident on the left bank (right-hand side of the image).	A "healthy" canyon relies on upstream and lateral sediment sources (landslips, tributary deliveries) to provide coarse-grained (bedload) sediments and wood to structure the river bed, maintaining the more than 200 rapids along the river course. This provides the "tools" the river requires to slowly evolve both vertically and laterally within its bedrock confines, maintaining the physical habitat diversity of the river (e.g., deep pools and waterholes). Turbidity levels vary in response to upstream land use impacts.
6. Whanganui River at the township and its mouth	Low-moderate sinuosity channel, with some midchannel bars towards the mouth.	The townsite of Whanganui sits on an extensive alluvial deposit that has built up in postglacial time. Bedload material is deposited in this low gradient reach before the coast. Typical of many river mouth towns, human-induced lateral constraints upon the river and dredging for navigation give the channel little capacity to adjust. Given the location of the town and the extensive upstream catchment area, flooding hazards are inevitable. Complex morphodynamic interactions with processes of longshore sediment transfer at the coast have been modified, as the channel has been "fixed" in place.

straightforward, as significant issues must be addressed in the generation of collective understanding and integration of knowledge within and between researchers, citizens, and management agencies. Rogers (2006) refers to this as the "real" river management challenge. Prospectively, processes of engagement that support the development of shared understandings of landscapes as biophysical-and-cultural entities can support such endeavours, remembering that fragmented knowledge can only engender fragmented practices and outcomes.

The Whanganui case study reflects a long and complex legal, social, and cultural history in which river rights have emerged in Aotearoa New Zealand. This has occurred in parallel with similar conversations and initiatives regarding the "rights of nature" elsewhere in the world (e.g., Boyd, 2017). Related discussions that are taking place on topics such as environmental flows (e.g., Arthington, 2012), resilience (Parsons & Thoms, 2017), and river health (Blue & Brierley, 2016) increasingly question the development and use of limited technical toolkits within predetermined institutional frameworks (see Tadaki et al., 2014).

This paper explores what geomorphologists and river scientists might contribute to articulating and supporting the rights of the river. In the western world, rights are commonly conceived and constructed around notions of property. In ancestral Māori perspectives, however, people and land are connected (not separated). Ancestral and genealogical linkages (*whakapapa*) engender roles as guardians (*kaitiakitanga*), with an ethos of collective benefits of a resource that recognizes that people cannot "own" land or water. Although legal rights are considered a universal, juridical concept, the rights of the Whanganui River mean something very specific in Aotearoa New Zealand. Elsewhere, legal framings may be contextualized in an entirely different way, exemplified by situations with deeply rooted property rights tied to rivers and water more generally (e.g., Ostrom & Hess, 2000; Sax, 1990). This paper draws on insights from river geomorphology to identify seven "rights" of a river that existing scientific framings and knowledge bases may help us to consider. However, by probing deeper into the meaning of the Whanganui River law, new opportunities for geomorphology and river science can be identified.

First, we contend that geomorphology—along with other river sciences—has much to offer to support thinking about the rights of a river and how these might be secured. Geomorphology shares many core values with Māori understandings of rivers, and there is much potential for generative synthesis. Potential contributions towards an integrating knowledge base include understanding the river's history, offering insights into a river's behaviour and processes operating across multiple scales, and valuing its holistic ecological and biophysical integrity (see Wilcock et al., 2013). Geomorphology provides conceptual and practical tools to support efforts to live with unpredictable changes, while considering how historical developments across the catchment affect present and future river form and function. Meeting such system-specific needs requires a flexibility that can be challenging to achieve in the tightly constrained and prescriptive world of legal precedence and associated governance arrangements. When operationalizing the rights of nature, geomorphology can help us to understand how rivers adjust and evolve over time, identifying changes that might be detrimental for a range of human and non-human entities. Scientists can help to set strong legal precedents by presenting evidence and conducting analyses of river systems that support holistic conceptions of rivers and strengthen the case for integrative cogovernance. In the case of the Whanganui River, for example, this refers to issues of geomorphic river diversity, capacity for adjustment, and connectivity relationships (see Figure 2, Table 2).

Viewed through a geomorphic lens, Māori relations to rivers and their rights as outlined in this paper might therefore emphasize the following perspectives on riverscapes, each of which finds resonance with recently developed approaches to geomorphologically informed river science and management that regard rivers as living entities (Everard & Powell, 2002):

1. An integrative catchment framing, viewing the river system as an interactive and interconnected whole from the mountains to the sea.
2. Understanding of the river as a living system and as kin, incorporating human activities and emphasizing mutual codependence (reciprocity) as determinants of its *ora* (health, well-being): What is good for the river is good for its people, and vice versa.
3. Respect for the inherent diversity and dynamic nature of river systems, recognizing the importance of living and working with the unique life force (*mauri*) and history (genealogy) of river systems, implicitly linking past, present, and future.

Second, geomorphology has much to learn from *Te Ao Māori* (the Māori world) and other indigenous perspectives. Scientists should ask how *Te Ao Māori* might suggest new directions for geomorphic inquiry, seeking to support—rather than lead—indigenous initiatives to articulate and institutionalize the rights of a river (cf., Hudson et al., 2016; Timoti, Lyver, Matamua, Jones, & Tahi, 2017). Significant advances have already been made in related fields in New Zealand, exemplified by kaupapa Māori assessment tools (Awatere et al., 2017), environmental report cards (e.g., Tipa et al., 2017) and sampling protocols informed by matauranga Māori (Kusabs, Hicks, Quinn, Perry, & Whaanga, 2018). As Section 4 shows, Māori concepts such as those embedded in the *Te Awa Tupua* law may resonate with existing scientific concepts, but they also demand thoughtful engagement with ethics, history, and science together. In the Whanganui case, legal provisions emphasizing the interconnectivity of human and non-human elements, along with their ethical interrelation, present a new vision of living with/in nature that river scientists could help to elaborate.

Third, the case study reinforces the need to understand how science can reify certain ways of living with nature. Inevitably, river scientists such as geomorphologists build upon selected societal and environmental values in framing their research questions and proposing interventions (e.g., Ashmore, 2015; King & Tadaki, 2018; Lave, 2012; Mould, Fryirs, & Howitt, 2018). Choices made have material outcomes. In many instances, working within a command and control ethos may seem a necessary prerequisite for efforts to influence river management decisions. Such institutional constraints preclude more generative approaches and practices, embellishing the status quo by merely slowing down rather than reversing negative sociocultural and environmental outcomes. In a similar sense, making the Whanganui a legal person with its own rights is a modernist device that reinforces a mode of governance based on property rights and

resource consents. The Te Awa Tupua Act represents a compromise between Whanganui iwi and the Crown (government), and Crown law is an imperfect structure for giving force to Māori values and what might be called Māori law (Charpleix, 2018; Ruru, 2018). Fundamentally, Crown law institutionalizes the assertion of human ownership and control over nature, which is arguably unethical and deserves rigorous challenge rather than passive acceptance. River scientists should ensure their work supports an agenda to pluralize and enrich the ethical foundations of river management, rather than reinforce colonial notions of ownership and control. This entails articulating the kinds of socio-natural relationships we want to create, and holding ourselves accountable to these ends. Desirable socio-natural relationships, we suggest, do not involve scientists enacting a new kind of colonialism over indigenous concepts and terms, or "selling nature to save it" (Dempsey, 2016). Rather, desirable relationships should centre on ethical relations of care and reciprocity (Jackson & Palmer, 2015) and on holistic concepts of "a good life," which involves social and environmental flourishing (Chan et al., 2016; Collard, Dempsey, & Sundberg, 2015). In this vein, river scientists can and should act as allies for indigenous peoples and as advocates for local communities, endorsing others' aspirations and offering their scientific authority in support of progressive visions of living with/in nature. Partnerships that incorporate such framings acknowledge the fundamental importance of cultural identity, building upon understanding and respect for multiple knowledge systems, values, and perspectives.

6 | CONCLUSION

There is no universal cure for what ails our rivers, but the exploration of coevolution between river systems and people, including the assignation of river rights, surely offers hopes and promises. Building upon a Māori framing of mutual codependence and reciprocity in relations to river systems incorporates a shared respect for living, flourishing, diverse, and evolving rivers that operate across scales, from local (site-specific) to reach- and catchment-scale applications. Through legitimizing and supporting mātauranga Māori perspectives on river rights, river scientists can contribute more directly and constructively to thinking about the rights of nature. The geomorphic principles upon which we can build knowledge and understandings of a landscape platform to support the river rights agenda, as suggested in Section 2, are merely one starting point and could be easily expanded by others in and beyond geomorphology. Process-based understandings of rivers as living systems (Everard & Powell, 2002), with their own histories and trajectories, present a fabric around which scientific, indigenous, and local knowledges can be woven.

It will take some time to see whether and how the rights of nature and related concepts in law and river management enable and support dynamic, flourishing, and living riverine ecosystems. In Aotearoa New Zealand, the Whanganui River legislation may prompt moves towards such goals. This paper outlines how scientists might position themselves within this institutional shift, contributing productively to conversations about socio-natural relations with rivers. Although reductionist elements or conceits about "rights" within property law may limit prospects to develop and adopt reframed practices, alternatively framed scientific practices can support new governance arrangements that prioritize environmentally just socio-environmental configurations. Perhaps, a more open and progressive river science might seek to support cultural movements to reconnect with rivers and embed moral relationships into management.

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REFERENCES

Arthington, A. H. (2012). *Environmental flows: Saving rivers in the third millennium (Vol 4)*. Berkeley: University of California Press.

Ashmore, P. (2015). Towards a sociogeomorphology of rivers. *Geomorphology*, *251*, 149–156.

Awatere, S., Robb, M., Taura, Y., Reihana, K., Harmsworth, G., Te Maru, J., & Watene-Rawiri, E. (2017). Wai Ora Wai Māori – a kaupapa Māori assessment tool. http://www.envirolink.govt.nz/assets/Envirolink/PB19-Wai-Ora-Wai-Maori-June-2017.pdf (sourced 21.04.2018)

Biron, P. M., Buffin-Bélanger, T., Larocque, M., Choné, G., Cloutier, C. A., Ouellet, M. A., … Eyquem, J. (2014). Freedom space for rivers: A sustainable management approach to enhance river resilience. *Environmental Management*, *54*(5), 1056–1073.

Blue, B. (2018). What's wrong with healthy rivers? Promise and practice in the search for a guiding ideal of freshwater management. *Progress in Physical Geography*, in press. 030913331878314

Blue, B., & Brierley, G. (2016). 'But what do you measure?' Prospects for a constructive critical physical geography. *Area*, *48*(2), 190–197.

Boyd, D. R. (2017). *The rights of nature*. Toronto: ECW Press.

Brierley, G., Fryirs, K., Cullum, C., Tadaki, M., Huang, H. Q., & Blue, B. (2013). Reading the landscape: Integrating the theory and practice of geomorphology to develop place-based understandings of river systems. *Progress in Physical Geography*, *37*(5), 601–621.

Brierley, G. J., & Fryirs, K. A. (2005). *Geomorphology and river management: Applications of the river styles framework*. Chichester: John Wiley & Sons.

Brierley, G. J., & Fryirs, K. A. (2016). The use of evolutionary trajectories to guide 'moving targets' in the management of river futures. *River Research and Applications*, *32*(5), 823–835.

Buffin-Bélanger, T., Biron, P. M., Larocque, M., Demers, S., Olsen, T., Choné, G., … Eyquem, J. (2015). Freedom space for rivers: An economically viable river management concept in a changing climate. *Geomorphology*, *251*, 137–148.

Chan, K. M., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., … Luck, G. W. (2016). Opinion: Why protect nature? Rethinking values and the environment. *Proceedings of the National Academy of Sciences*, *113*(6), 1462–1465.

Charpleix, L. (2018). The Whanganui River as Te Awa Tupua: Place-based law in a legally pluralistic society. *The Geographical Journal*, *184*(1), 19–30.

Chorley, R. J. (1969). The drainage basin as the fundamental geomorphic unit. In R. J. Chorley (Ed.), *Water, Earth and Man* (pp. 77–99). London: Methuen.

Collard, R. C., Dempsey, J., & Sundberg, J. (2015). A manifesto for abundant futures. *Annals of the Association of American Geographers*, *105*(2), 322–330.

Davis, W. M. (1906). The geographical cycle in an arid climate. *The Geographical Journal*, *27*(1), 70–73.

Dempsey, J. (2016). *Enterprising nature: Economics, markets, and finance in global biodiversity politics*. Chichester: John Wiley & Sons.

Dufour, S., & Piégay, H. (2009). From the myth of a lost paradise to targeted river restoration: Forget natural references and focus on human benefits. *River Research and Applications*, *25*(5), 568–581.

Eaton, B., & Millar, R. (2017). Predicting gravel bed river response to environmental change: the strengths and limitations of a regime-based approach. *Earth Surface Processes and Landforms*, *42*(6), 994–1008.

Everard, M., & Powell, A. (2002). Rivers as living systems. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *12*(4), 329–337.

Fox, C. A., Reo, N. J., Turner, D. A., Cook, J., Dituri, F., Fessell, B., … Turner, A. (2017). "The river is us; the river is in our veins": Re-defining river restoration in three Indigenous communities. *Sustainability Science*, *12*(4), 521–533.

Fryirs, K., & Brierley, G. J. (2009). Naturalness and place in river rehabilitation. *Ecology and Society*, *14*(1).

Fryirs, K. A. (2015). Developing and using geomorphic condition assessments for river rehabilitation planning, implementation and monitoring. *Wiley Interdisciplinary Reviews: Water*, *2*(6), 649–667.

Fryirs, K. A., Brierley, G. J., Preston, N. J., & Kasai, M. (2007). Buffers, barriers and blankets: the (dis) connectivity of catchment-scale sediment cascades. *Catena*, *70*(1), 49–67.

Fryirs, K. A., Wheaton, J. M., & Brierley, G. J. (2016). An approach for measuring confinement and assessing the influence of valley setting on river forms and processes. *Earth Surface Processes and Landforms*, *41*(5), 701–710.

Harmsworth, G., Awatere, S., & Robb, M. (2016). Indigenous Māori values and perspectives to inform freshwater management in Aotearoa-New Zealand. *Ecology and Society*, *21*(4).

Hikuroa, D. (2017). Mātauranga Māori—the ūkaipō of knowledge in New Zealand. *Journal of the Royal Society of New Zealand*, *47*(1), 5–10.

Hudson, M., Collier, K., Awatere, S., Harmsworth, G., Henry, J., Quinn, J., … Robb, M. (2016). Integrating indigenous knowledge into freshwater management: an Aotearoa/New Zealand case study. *International Journal of Science in Society*, *8*, 1–14.

Jackson, S., & Palmer, L. R. (2015). Reconceptualizing ecosystem services: Possibilities for cultivating and valuing the ethics and practices of care. *Progress in Human Geography*, *39*(2), 122–145.

Kasprak, A., Hough-Snee, N., Beechie, T., Bouwes, N., Brierley, G., Camp, R., … Rosgen, D. (2016). The blurred line between form and process: A comparison of stream channel classification frameworks. *PLoS One*, *11*(3), e0150293.

Kennedy, B. (2012). I am the river and the river is me: The implications of a river receiving personhood status. *Cultural Survival*. December 2012. Sourced from: www.culturalsurvival.org/publications (15.06.2018)

King, L., & Tadaki, M. (2018). A framework for understanding the politics of environmental science (Core tenet #2). In R. Lave, C. Biermann, & S. Lane (Eds.), *The Palgrave Handbook of Critical Physical Geography* (pp. 67–88). Palgrave Macmillan.

Knight, C. (2016). *New Zealand's rivers*. (p. 323). An Environmental History: Canterbury University Press, Christchurch.

Kondolf, G. M. (2011). Setting goals in river restoration: When and where can the river "heal itself"? In A. Simon, S. J. Bennett, & J. M. Castro (Eds.), *Stream restoration in dynamics fluvial systems: Scientific approaches, analyses and tools* (Vol. 194). *American Geophysical Union, Geophysical Monograph Series* (pp. 29–43).

Kusabs, I. A., Hicks, B. J., Quinn, J. M., Perry, W. L., & Whaanga, H. (2018). Evaluation of a traditional Māori harvesting method for sampling kōura (freshwater crayfish, *Paranephrops planifrons*) and toi toi (bully, *Gobiomorphus* spp.) populations in two New Zealand streams. *New Zealand Journal of Marine and Freshwater Research*, https://doi.org/10.1080/00288330.2018.1481437

Lave, R. (2012). *Fields and streams: Stream restoration, neoliberalism, and the future of environmental science*. Athens: University of Georgia Press.

Marsden, M. (2003). Kaitiakitanga: A definitive introduction to the holistic worldview of the Māori. In T. A. C. Royal (Ed.), *The Woven Universe* (pp. 54–72). Ōttaki: Te Wānanga o Raukawa.

Montgomery, D. R. (1999). Process domains and the river continuum. *JAWRA Journal of the American Water Resources Association*, *35*(2), 397–410.

Morgan, T. K. K. B. (2006). Decision-support tools and the indigenous paradigm. *Proceedings of the Institution of Civil Engineers-Engineering Sustainability*, *159*(4), 169–177.

Mould, S. A., Fryirs, K., & Howitt, R. (2018). Practicing sociogeomorphology: Relationships and dialog in river research and management. *Society & Natural Resources*, *31*(1), 106–120.

Nanson, G. C., & Huang, H. Q. (2017). Self-adjustment in rivers: Evidence for least action as the primary control of alluvial-channel form and process. *Earth Surface Processes and Landforms*, *42*(4), 575–594.

National Policy Statement for Freshwater Management. (2014). Sourced from: www.mfe.govt.nz (30.04.2018)

O'Donnell, E., & Talbot-Jones, J. (2018). Creating legal rights for rivers: Lessons from Australia, New Zealand, and India. *Ecology and Society*, *23*(1).

Ostrom, E., & Hess, C. (2000). Private and common property rights. In B. Bouckaert, & G. de Geest (Eds.), *Encyclopedia of Law and Economics* (Vol. 2) (pp. 53–106).

Parsons, M., & Thoms, M. C. (2017). From academic to applied: Operationalising resilience in river systems. *Geomorphology*, *305*, 242–251.

Piégay, H., Darby, S. E., Mosselman, E., & Surian, N. (2005). A review of techniques available for delimiting the erodible river corridor: A sustainable approach to managing bank erosion. *River Research and Applications*, *21*(7), 773–789.

Pillans, B. (1994). Direct marine-terrestrial correlations, Wanganui Basin, New Zealand: the last 1 million years. *Quaternary Science Reviews*, *13*(3), 189–200.

Rogers, K. H. (2006). The real river management challenge: Integrating scientists, stakeholders and service agencies. *River Research and Applications*, *22*(2), 269–280.

Ruru, J. (2009). Undefined and Unresolved: Exploring Indigenous rights in Aotearoa New Zealand's freshwater legal regime. *Journal of Water Law*, *20*(5–6), 236–242.

Ruru, J. (2012). The right to water as the right to identity: legal struggles of indigenous peoples of Aotearoa New Zealand. In *The Right to Water: Politics, governance and social struggles* (pp. 110–122). Abingdon, UK: Earthscan.

Ruru, J. (2018). Listening to Papatūānuku: A call to reform water law. *Journal of the Royal Society of New Zealand*, 1–10.

Salmond, A. (2014). Tears of Rangi: Water, power, and people in New Zealand. *HAU: Journal of Ethnographic Theory*, *4*(3), 285–309.

Salmond, A. (2017). *Tears of Rangi: Experiments across worlds*. Auckland: Auckland University Press.

Salmond, A. (2018). Rivers as ancestors and other realities: Governance of waterways In Aotearoa/New Zealand. In B. Martin, L. Te Aho, & M. Humphries (Eds.), *ResponsAbility. Law and governance for living well with the earth*. UK: Routledge. Chapter 12.

Sax, J. L. (1990). The constitution, property rights and the future of water law. *University of Colorado Law Review*, *61*, 257–282.

Šunde, C. (2008). The water or the wave? Toward an ecosystem approach for cross-cultural dialogue on the Whanganui River, New Zealand. In D. Waltner-Toews, J. J. Kay, & N.-M. Lister (Eds.), *The ecosystem approach: Complexity, uncertainty, and managing for sustainability*. New York: Columbia University Press.

Tadaki, M., Brierley, G., & Cullum, C. (2014). River classification: Theory, practice, politics. *Wiley Interdisciplinary Reviews: Water*, *1*(4), 349–367.

Te Aho, L. (2010). Indigenous challenges to enhance freshwater governance and management in Aotearoa New Zealand—The Waikato River settlement. *The Journal of Water Law*, *20*(5), 285–292.

Thomas, A. C. (2015). Indigenous more-than-humanisms: Relational ethics with the Hurunui River in Aotearoa New Zealand. *Social & Cultural Geography*, *16*(8), 974–990.

Timoti, P., Lyver, P., Matamua, R., Jones, C., & Tahi, B. (2017). A representation of a Tuawhenua worldview guides environmental conservation. *Ecology and Society*, *22*(4).

Tipa, G. T., Williams, E. K., van Schravendijk-Goodman, C., Nelson, K., Dalton, W. R. K., Home, M., … Quinn, J. (2017). Using environmental report cards to monitor implementation of iwi plans and strategies, including restoration plans. *New Zealand Journal of Marine and Freshwater Research*, *51*, 21–43.

Tribunal, W. (1999). *Whanganui River report*. Wellington: The Waitangi Tribunal.

Whanganui River Charter. (1993). The Whanganui River Charter on Tino Rangatiratanga and Iwi Water Rights. Sourced from: www.wrmtb.co.nz (24.06.2018)

Wiens, J. A. (2002). Riverine landscapes: Taking landscape ecology into the water. *Freshwater Biology*, *47*(4), 501–515.

Wilcock, D., Brierley, G., & Howitt, R. (2013). Ethnogeomorphology. *Progress in Physical Geography*, *37*(5), 573–600.

WWAP (United Nations World Water Assessment Programme)/UN-Water (2018). *The United Nations world water development report 2018: Nature-based solutions for water*. Paris: UNESCO.

Yates, J. S., Harris, L. M., & Wilson, N. J. (2017). Multiple ontologies of water: Politics, conflict and implications for governance. *Environment and Planning D: Society and Space*, *35*(5), 797–815.

Young, D. (2013). *Rivers: New Zealand's shared legacy*. Auckland, New Zealand: Random House.

Young, D. C., & Foster, B. (1986). *Faces of the river: New Zealand's living water*. Auckland: TVNZ Publishing.

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