



Living and knowing sacred groundwater: Entangled knowledge in the Martuwarra Fitzroy River Region, Kimberley, Western Australia

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Abstract

An alternative conception to scientific hydrogeological knowledge and approaches that informs extractive and exploitative interests is presented for the Martuwarra Fitzroy River Region, Western Australia. In this alternative view, developed on a foundation of ancestral personhood, the entangled skeins of Martuwarra knowledges, languages, deep histories, and stories are traced to propose a just and equitable approach to co-governance of the region. This paper highlights the critical role of the intergenerational transfer of ancient cultural knowledges and practices between generations in shaping understandings of the River ecosystem.

Keywords Aboriginal knowledges · Counter narratives · Women's Stories · Fracking · Water governance

Introduction: River of Life: Martuwarra Fitzroy River, people, and country

The Martuwarra (Fitzroy River) in Australia is a special, significant, and sacred country to the Nyikina and other Yi-Martuwarra people. The Yi-Martuwarra people are the First Australians and are understood as one society under Warloongarri law. The First Law of the river, which connects sea, desert, and hill or ranges country, binds the people under a moral obligation of collective care to promote and protect Martuwarra's right to live and flow. This River of Life, deeply embedded in ancient and enduring cultural values and ancestral First Laws, is governed as a single, living entity, with people and river regarded as one living being.

This paper proposes an alternative vision for the co-governance of the river and its environs (e.g., Neville and Coulthard 2019), based on First Laws and ancestral knowledge. This offers a counter-narrative to the rational, scientific, hydrogeological knowledge and approaches that underpin interests in the potential to exploit the geothermal materials in the region (Moggridge 2020). In this paper, we will use the term groundwater to denote geothermal materials, which include 'fossil water' (sometimes known as 'paleowater') as a subset of groundwater, and which takes tens of thousands of years (or more) to recharge (see for example Martin-Nagle 2011; Slater 2021). At some points in the paper, however, the term 'fossil water' is specifically employed to emphasize an ancient type of water system, which takes hundreds of thousands of years to regenerate or recharge.

As a single, living entity, the river embodies life and culture for Yi-Martuwarra people. It is a storied ecological land- and river-scape, rich in natural and cultural resources. The ancient and enduring Warloongarri Law and other First Laws and deeply embedded ancestral knowledges imbue the riverine ecology with significance and form the frame in which the First Australians for this region govern it. In this frame, the transfer of intergenerational knowledge between generations is important for intergenerational equity. It is fundamental for the rights of our young people, both Indigenous and non-Indigenous, to learn and share their duty to care for groundwater. This sharing and transfer of knowledge

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and best practices, informed by our critical cultural and spiritual values is essential for our caring of country, as all the living groundwater systems are connected to Martuwarra and Warloongarray Law. Its people's deeply held spiritual beliefs are grounded in their values, ethics and virtues as a duty of care under First Law (Milgin et al. 2020) to protect public interests, Martuwarra, and the whole living system. This is recognized in the 2011 listing of the West Kimberley region on the Australian Register of the National Estate.

The heritage values in the listing include acknowledgement of the living ancestral serpent beings among other values, an important contribution to the listing (Australian Government Heritage Database 2011). The heritage listing also facilitates the recognition and incorporation of cultural values into thinking and acting for an ethic of care, for justice for the Martuwarra and its people, and for the common good and public interest (Page and Pelizzon 2022). Adopting this frame, we can strive for the protection of the peoples' stories within a wider context of the Martuwarra Fitzroy River catchment. It is a fundamental, life-affirming part of the Martuwarra peoples' country. But, like all riverine ecologies, it is vulnerable not only to the ravages of the climate crisis but also to the persistent demands and interests of extractive industries, including hydraulic fracturing ('fracking') and other forms of oil and gas exploration (Montgomery and Smith 2010; Reins 2011). For the Nyikina and other First Australians, the groundwater and other geothermal reserves that are the focus for these activities and interests, are part of sacred country, seen as a holistic connected cultural landscape which was fashioned, and continues to be nurtured and maintained through story, tradition, knowledges, and practices. There are many stories told, especially by the old people, including senior women of high degree, among others, of the Dreamings and ancestral beings, of those who created the sacred sites and areas, the waterholes, creeks, tributaries, catchments and all the riverine ecosystems of the Martuwarra Fitzroy River (WA Government 2023).

In this paper, we make a case for an alternative conception to the scientific hydrogeological knowledge and approach that informs extractive and exploitative interests in the Martuwarra Fitzroy River. In this alternative view, developed on a foundation of ancestral personhood, we tease out the entangled skeins of Martuwarra knowledges, languages, deep histories, and stories to propose a just and equitable approach to water extraction, planning and management through co-governance. In developing this alternative vision for river governance, the critical role that Martuwarra Indigenous worldviews, along with ancient knowledges and practices, is highlighted in shaping understandings of the river ecosystem. These Indigenous knowledges also make important contributions to the formation of scientific approaches to hydrogeology. The argument put forward in this paper is that Martuwarra knowledges and practices, which are referred to as Indigenous science, while contributing to the

overall formation of a rational, computative, and quantitative hydrogeological scientific knowledge, also provide a foundation for a critique of the scientific approach (Harriden 2023). Alternatives, or counter-narratives to the 'Western' rational-scientific approach to geothermal activities and, in turn, groundwater extraction, has also been discussed in a feminist framework, which aligns with an Indigenous scientific paradigm (Bosworth 2017). The development of a concept for adaptive water management and governance for the river and the region encompasses cultural and social values and understandings that enable adaptive strategies for climate adaptation, resilience, and new economies to be developed for the river and the region.

A brief critique of extractive development interests in the Martuwarra Fitzroy River and environs is presented, with specific reference to destructive activities such as fracking in the surveying and development of hydrogeological resources, including fossil water and other types of groundwater. These activities have profound and detrimental impacts of harm on peoples' livelihoods and on the sacred river. This aspect of the discussion considers some of the ways in which the Kimberley Aboriginal communities have stood strong, to resist inadequately informed development of the region.

The paper then presents a discussion of Yi-Martuwarra, concepts, laws, and ways of knowing and relating to the river and its environs. In this regard, some conventional hydrogeological terms are questioned, such as 'resources', to describe what developers and others seek to exploit (Laborde and Jackson 2022). The term 'resources' is framed within the context of Martuwarra culture, laws, heritage, and Indigenous ecological science and knowledge.

The paper weaves together two different perspectives – Aboriginal, and Western scientific knowledge to inform better practice and ways of thinking about and engaging with the river in all its dimensions. Threading a path through these diverse stories of the river and its environs, the paper considers some alternative approaches to governance of the river as a bioregion. This concept of alternative bioregional/river governance envisages a networked and collaborative model, which is outlined in the discussion below.

Discussion

Extractive interests in the Martuwarra Fitzroy River Region and Aboriginal narratives

The region that encompasses the Martuwarra Fitzroy River attracts wide-ranging interests from mining, government, scientific, and other sectors, eager to exploit its many natural 'resources'. As well as mineral resources, the river offers extractive possibilities, including groundwater. The survey and extraction activities have very significant

potential and actual consequences for the river in all its shapes and forms, including the water that lies underneath the surface, and the tributaries, lakes and streams that flow throughout the vast 92,000 km² region. What is important to understand is the holistic nature of the Martuwarra Fitzroy River. It is viewed as a single living entity (Poelina et al. 2024). The region and the river are listed as National Heritage at both Commonwealth through the Environment Protection and Biodiversity Conservation Act 1999 and state levels through the Aboriginal Heritage Act 1972 (WA) (AHA) (site #12,687). The recognition of its intrinsic heritage value must take into account Martuwarra Aboriginal peoples' perceptions and spiritual understandings, which guide our moral obligation and duty of care for the river and its environs and non-human kin (e.g., Kolig 1981). If impacted, any extractive activities on the river and its catchment will result in moral harm. The 2011 listing for the West Kimberley on the National Heritage Register (listed August 31, 2011, Place ID 106063, Place File (5/09/213/0034) describes the area as follows:

“Rainbow Serpent traditions tied to Indigenous interpretations of the different way in which water flows within the catchment”

The Rainbow Serpent is an important Creation Being for Aboriginal people across Australia and is closely linked to land, water, life, social relationships and fertility. There are many stories associated with the serpent, all of which communicate the significance and power of this Being within Aboriginal traditions. Within the Fitzroy River catchment are four distinct expressions of the Rainbow Serpent tradition. In the jila-kalpurto domain of the Fitzroy catchment on the northern edge of the Great Sandy Desert, water flows are principally underground and the Rainbow Serpent (kalpurto) is said to exist in the underground structure of the channels, linking excavated waterholes and other water sources of significance. Places like Kurrpurrngu, Mangunampi, Paliyarra, Kurungal and Yoongoorrookoo exemplify this expression of the Rainbow Serpent.

The phenomenon of Galaroo, on the other hand, is linked to flowing surface water in the form of major rivers and flows to long and deep permanent waterholes in broad river channels, like Geikie Gorge (Danggu). The Rainbow Serpent of the Wanjina-Wunggurr belief system, known as Wunggurr, is typically found in discrete pools of water and is also associated with the sea and with Wandjina Creator Beings at painted sites and in religious narratives. The upper Hann River is an exemplar of this aspect of the Rainbow Serpent tradition, while the Woonyoomboo-Yoongoorrookoo narrative of the

lower Fitzroy primarily tells the story of the creation of the lower Fitzroy River and its floodplains and links to the sea.

The Fitzroy River and a number of its tributaries, together with their floodplains and the jila sites of Kurrpurrngu, Mangunampi, Paliyarra and Kurungal, demonstrate four distinct expressions of the Rainbow Serpent tradition associated with Indigenous interpretations of the different ways in which water flows within the catchment and are of outstanding heritage value to the nation under criterion (d) for their exceptional ability to convey the diversity of the Rainbow Serpent tradition within a single freshwater hydrological system” (Australian Government National Heritage Database 2011).

This description of the ancestral domain forms one of the central foundations upon which our alternative concept of river governance is developed and is also a basis for our critique of the Western scientific hydrogeology disciplinary and applied approach. To further offer some idea as to how we see our mapping of these different ways of knowing – Indigenous knowledges with Western-scientific hydrogeology, reference is made to Grace Mulligan's maps, which illustrate the connectivity of traditional knowledge systems between, land, sky, rain, living waters; surface and groundwater and people (RiverOfLife et al. 2020).

Hydrogeology and the Martuwarra Fitzroy River Catchment

The science and technology of surveying and mining have advanced considerably in recent years. One significant development is hydraulic fracturing, otherwise known as ‘fracking’. It is just one of many ways of enabling the extraction of geological and geothermal resources, including oil, gas, and coal. These kinds of invasive technologies have critical implications for water and the entire ecosystem and, therefore, for communities. The implications may be examined in a frame broadly termed as ‘hydrosocial’ (Liao and Schmidt 2023), as outlined by Budds et al. (2014) for example:

“The once deeply engrained idea that water management should be considered as a technical endeavor that is appropriately confined to hydrological science and hydraulic engineering has now largely ceded to the recognition that water issues also comprise important spiritual, social and political dimensions that call for the involvement of social science and multiple stakeholders.

Unlike conventional studies that focus on the relationship between humans and water conceived of as two distinct categories that interact with one another, considering water as spiritual and socioecological makes

it impossible to abstract water from the social context that gives it meaning and from the socio-political processes that shape its material flows and its discursive representation. In line with this perspective, the notion of a *hydrosocial*, as opposed to a *hydrological*, cycle has gained traction as a means of both capturing and integrating the socio-political and biophysical processes that constitute water, as well as highlighting the limitations of traditional science and practice” (Budds et al. 2014).

What lies beneath: Groundwater

It is not only the visible water that is of interest to developers and extractive interests. There is a great deal more that is of potential interest, including within the vast and ancient layers that lie beneath the lands and the rivers. In a hydrogeological world, there is a vast, potentially untapped and as yet unknown reserve of groundwater. What are considered to be ‘resources’ in an extractive hydrological and hydrogeological context, is otherwise significant and sacred Aboriginal cultural heritage for the Martuwarra peoples. Beyond the sacredness, the transfer of intergenerational knowledge and duty of care towards greater public interest matters. It is grounded in observations over thousands of years, recorded and shared in song, dance and ceremony; an Indigenous scientific perspective grounded in reading the whole cultural landscape and the connectivity of underground water systems.

The Elders are the primary authors of this paper, as they have the authority to “sing the songs” and to explain how these systems are connected underground from place to place. The story of the Blue-tongue Lizard and the death of the King Brown Snake carries a warning that disturbing this sacred, geothermal, living groundwater place may trigger seismic activity. Such narratives, which embody Indigenous science, need to be embedded in water law, planning, and water policy, all of which are inherently place-based. Through the continuity of Aboriginal perspectives informed by cultural knowledge traditions and First Law, an important connection can be discerned between these understandings and the increased risk of seismic activity associated with fracking and other geothermal extractive activities. (e.g., Aczel and Makuch 2019; Ellsworth 2013).

In Australia, while all jurisdictions have policies and regulations around groundwater, these aspects are relatively less developed (especially regarding sustainability issues) than those concerning surface water. Current approaches to the management of water often fail to consider the hydrological cycle. Political and legal systems do not acknowledge atmospheric rivers, rain, underground aquifers and permafrost within existing constitutional water frameworks and policies (Poelina 2023).

Groundwater within the Martuwarra catchment is stored within the Grant, Poole, and Liveringa Group aquifers. Notably, groundwater in the Pool Sandstone has been dated to an age of 31,000 years (Taylor et al. 2018). The water present in these aquifers, some of which infiltrated during the previous geological epoch, the Pleistocene, holds immense ecological and cultural significance. From the perspective of the Martuwarra people, the notion of ‘living water’ embraces, in addition to permanent surface water, ancient waters, sometimes known as ‘fossil’ waters. This fossil water plays a vital role in sustaining life within the Martuwarra catchment by serving as a buffer against the adverse impacts of climate change. These groundwater reservoirs are vital to adaptive water management to sustain ecosystem resilience in the semi-arid, highly variable climate of the West Kimberley region, Australia.

Fossil water resources are classified as non-renewable because their recharge occurs at a rate that is considerably slower than that of proposed industrial-scale extraction. To date, there are limited Western scientific data on the recharge rates and the connectedness between underground living water systems in the Fitzroy River Catchment. Many studies have shown that extractive exploitation of groundwater leads to depletion followed by environmental degradation and ecosystem collapse. The mining and extractive activities occurring around the Gngangara groundwater system in Western Australia are just one of many such examples (Broderick and Horwitz 2014). These extractive processes have far-reaching consequences for the entire ecosystem and for the communities in the region. We, the authors of this paper, draw attention to the need to carefully consider the implications of these extractive activities for the social, cultural, and spiritual domains (see also Budds et al. 2014).

Within the Martuwarra Catchment, there exists a limited Western comprehension of the extent, interconnectedness, and overall complexity of groundwater reservoirs. Before granting any water licenses for groundwater extraction in the Fitzroy Valley, the Western Australian government must exercise fundamental due diligence and adhere to the ethical considerations of the precautionary principle, ‘do no harm’. That principle, derived from international environmental principles (Peel 2009), has been one of the foundations of Australian environmental law and policy. The 1992 *Rio Declaration* articulated the precautionary principle (Principle 15), which provides that (UNGA 1992):

“In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation”.

In Australia, the precautionary principle was one of the guiding principles in the National Strategy for Ecologically Sustainable Development (NSES), which was endorsed by the Council of Australian Governments in December 1992 (Peel 2009; Peterson 2006). The precautionary principle is also a key provision in the Commonwealth environment law, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act, at Sect. 391) (Peterson 2006).

In exercising an ethical stance and the precautionary principle, firstly, the Western Australian Government must conduct thorough investigations of all groundwater reservoirs to obtain an in-depth understanding of the intricate systems and the potential impacts of groundwater extraction for future generations. These are public interest matters that call on the fiduciary duties of government to protect the wellbeing of current and future generations of Australians. Climate justice and water justice (Sultana 2018, 2022) emphasize this duty of care as a basic human right to live on the river country sustaining their collective lifeways and livelihoods in a time of great uncertainty with climate change (RiverOf-Life et al. 2024). A reasonable expectation of people living in West Australia is that their government protects the interests of its citizens, industry and business. The minimum scientific standard of confidence is for the government to invest in a comprehensive scientific study to generate evidence and understanding of the groundwater recharge rates within the Martuwarra Fitzroy River catchment. Good faith begins from the principle of do no harm through applying the precautionary approach. Secondly, it is crucial to communicate to stakeholders and the general public that the consequences of extraction will have extraordinarily long-lasting impacts, and what these impacts might be.

Groundwater, with its stability amidst climate fluctuations, is crucial for mitigating the impacts of climate change. As precipitation patterns become erratic, these reservoirs provide a consistent water source for ecosystems. They also offer resilience during extreme weather events, sustaining diverse life along the Martuwarra. Long-term planning, prioritizing preservation in groundwater management strategies, is critical to climate adaptation of West Kimberley. Groundwater reservoirs provide a dependable buffer against the negative effects of climate change and provide water security for ecosystems and communities for the future.

As previously stated, this paper pursues an argument for taking seriously the socio-cultural and spiritual dimensions of survey and extractive activities involving hydrogeological and geothermal resources, including groundwater. In consideration of the hydrosocial cycle (Budds et al. 2014), the critical importance of Martuwarra peoples' First Laws, ancient knowledge systems and ancestral domains are highlighted, which formulate ways of thinking about and relating to water as a single living entity in the Kimberley. In this holistic worldview and framework, we suggest that humans,

water, land and the environment are inseparable and that there are many dimensions to thinking about water and the Martuwarra River and its catchment.

One of these dimensions is economic/financial. The considerable costs involved in surveying, mining and fracking extend to the large volumes of water consumed for these processes and activities. Therefore, water is money, and money is water. These complex economic and socio-economic aspects may be partly described by the phrase 'water-money' (De Rijke 2018).

Standing strong: Resistance and activism

The extractive interests and activities in the Martuwarra Fitzroy River region have prompted our people to resist, seeking to protect this precious and sacred country. Yi-Martuwarra peoples' activism and resistance are underpinned and informed by their First Laws and ancestral Dreamings for Martuwarra Fitzroy River Country.

Kimberley Aboriginal peoples' activism came to public attention when, in 1980 communities from around the Martuwarra Fitzroy River region stood up and protested against drilling and mining proposals by the Amax Petroleum Company. All the senior women authors of this paper were at the front line of this activism, actively involved in the political struggle then and now to respect and save sacred living groundwater. This story captures and transfers intergenerational knowledge across generations. Elders observed that when the drilling reached the geothermal water, it erupted and sprayed water everywhere. It is possible that the drill punctured a shallow geothermal groundwater spring or reached a deeper confined aquifer where geothermal groundwater was stored.

The complex history of the actions by Amax at Noonkanbah and how it impacted on Kimberley Aboriginal people is told in many places (e.g., Poelina 2023; Moizo 1991). The Noonkanbah story illustrates the conflict of values of development on just terms, the lack of a social license involving sacred ground and sacred heritage places, the activism of leaders to prevent geothermal extractive interests by companies such as Amax, and the deeply embedded cultural and sacred values held by Yi-Martuwarra people in water, including groundwater (Hughes and Howes 1981).

Extractive interests have also been pursued around Dangaba, also known as Dunggaba. Our people share their stories about Dangaba/Dunggaba, a series of five significant complexes located in the vicinity of Noonkanbah, which are listed on the West Australian (WA) Heritage Register (e.g., Poelina et al. 2023; Lilienthal et al. 2024). This special area is also a geothermal site, which is of interest to fracking and other extractive activities. The Dangaba/Dunggaba sites are just some of many sites on country where two narratives of

fracking and other extractive activities become entangled and intertwined.

The Elders' story: Standing strong for rights and justice

The experiences of the Elders and others at Noonkanbah in the 1980s offer powerful lessons for ways to approach and think about challenging and resisting the present-day extractive interests in the region's riverine systems and ecologies. In a profound sense, the continued despoilation of hydrological resources in the Kimberley, which includes many culturally significant and sacred sites, is in the realm of an ecological and cultural catastrophe.

The peoples' resistance to the mining at Noonkanbah is included in the information in the National Heritage listing, referred to in the section '*Aboriginal rights to practice law and culture*'. It states, "When Aboriginal people speak about 'Nookanbah', they are referring to a series of events which took place on Noonkanbah Station between 1978 and 1980. These events drew the attention of the nation to the struggle of the Aboriginal people to protect their rights to practice law and culture". The Australian Government Heritage Database (2011) provides the following details:

"The areas of Noonkanbah station encompassing the station gates, the crossing at Mickey's Pool, Pea Hill (Umpampurru) and the unsuccessful exploration well, have outstanding heritage value to the nation under criterion (a) as the site of the Noonkanbah dispute, an important event in the national struggle of Aboriginal people to have their rights to practice traditional law and culture recognized, and to protect their heritage for future generations" (Australian Government Heritage Database 2011).

This reference to the peoples' resistance at Noonkanbah is just one of many stories to be embraced in positing an oppositional discourse to the extractive geothermal groundwater, narrative and the need for precautionary principles to be embedded in the extraction of groundwater.

Water stories

Kimberley Aboriginal People have held fast to their cultural strength in the face of powerful capitalist-extractive interests and activities, as demonstrated at Noonkanbah. Forty years after these events, some of the Nykina Elders recorded their stories about the protests against the Noonkanbah mining, including Lucy Marshall, who shows clarity about their role in society and what government and leadership requires:

"We can run the country. We know what the rules are. We never forget. Together. Together shoulder to shoul-

der. We know what's right and what's wrong. Sorry about that, but we still got our culture. We still got our role. We still got a role to play".

There is shock but no surprise at the absence of attention to the concerns of Indigenous Elders about the effects of polluting industries on their country (Lilienthal et al. 2024).

This is further supported in the stories by senior Nykina Elders on Noonkanbah, Rosie Mulligan, Madeline Yamera and Lucy Walgarie also made 40 years later. As we have argued elsewhere, "These Elders powerfully establish their authority to speak for Noonkanbah and demonstrate their understanding of the hydrological and spiritual threat fracking poses to their river country and community. This is sacred knowledge only shared because of their "deep understanding" (Lilienthal et al. 2024).

These women's concerns about the devastating pollution and other damage that mining and extractive activities inflict on the river and its environs remain unchanged. The protests by the Elders, including Rosie Mulligan, Grace Mulligan, Madeline Yamera, and Lucy Walgaie were central to the development of the national movement for land rights. These Elders powerfully establish their authority to speak for Noonkanbah and demonstrate their understanding of the hydrological and spiritual threat fracking poses to their river country and community. At present, the activism against mining and fracking highlights the importance of pursuing appropriate regenerative development and alternative forms of governance (Figs. 1 and 2).

The crucial importance of these women's stories is that they also powerfully demonstrate intergenerational transfer of cultural knowledge to the younger generation. These stories are deeply embedded with ecological and cultural knowledge that form the foundation for resilience and adaptation in the face of destructive extractive activities and the ravages of climate change. In the film 'Sitting on Sacred Ground', Elders talk about the old ways, living from the land and river with its abundant food and other resources. They plea to the government to not allow fracking on their country as they want the right to have a peaceful life. Their message to young leaders is to listen to their wisdom and warning so that the young generation can be safe (Lilienthal et al. 2024; Knight et al. 2024). This is why they made their film (see Poelina et al. 2014). The intergenerational transmission of knowledge of these ancient practices was, and remains, crucial to community identity, spirituality, and customary practices. Sacred Living Groundwater sites, such as the Doodoodoo/Dududu, as seen in Fig. 3, are registered as heritage sites.

The Elders' stories also highlight the ancestral domain and First Laws that are vital to seeing the river and its environs as a single living entity, as having 'ancestral personhood' (Lilienthal et al. 2024; Knight et al. 2024). As the

Fig. 1 Mijirikan. Photograph accreditation: Alexander Hayes

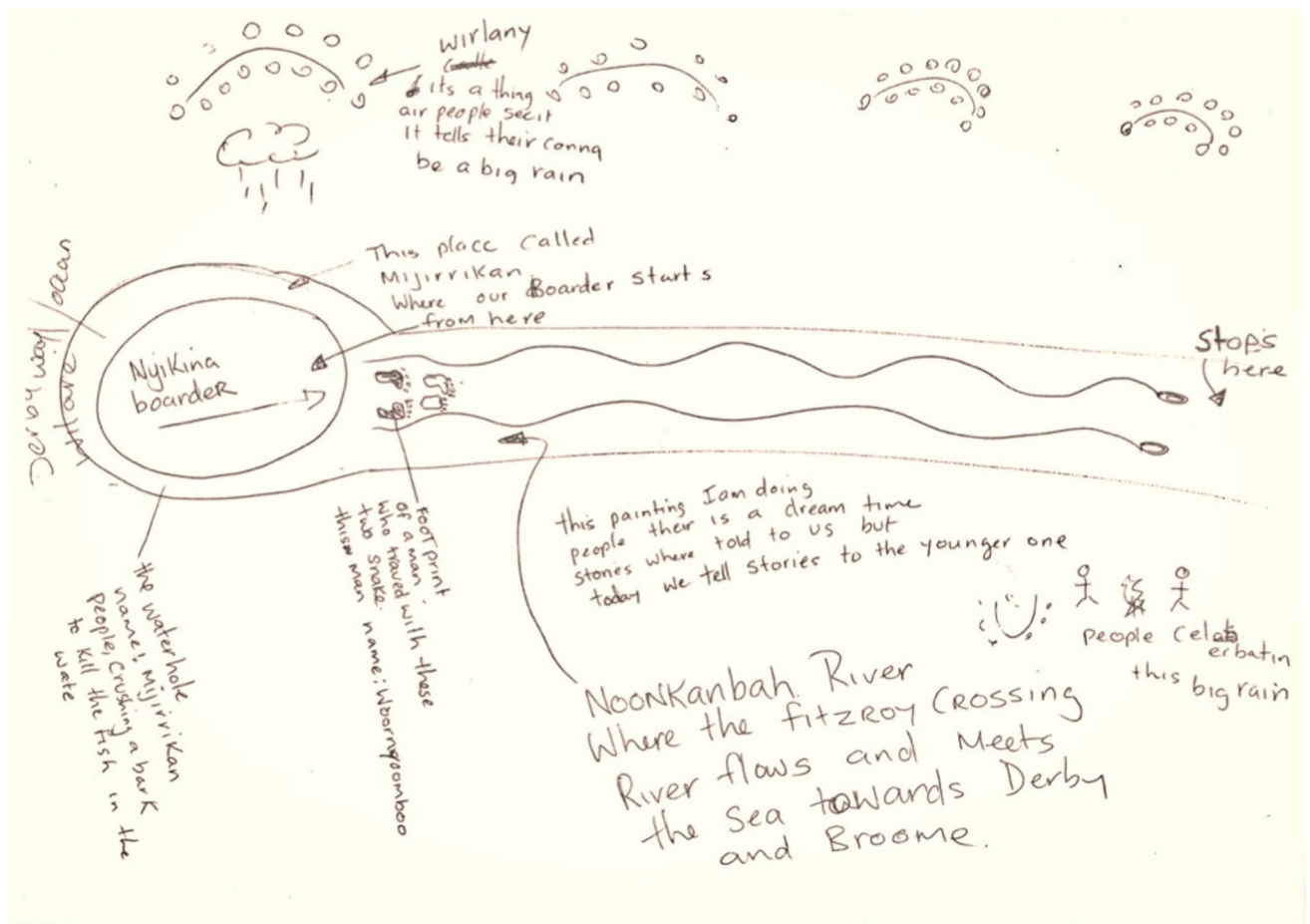


Fig. 2 Explanation of images in the Mijirikan Map. Photograph accreditation: Alexander Hayes

Fig. 3 Doodoodoo Geothermal Pool. Photograph accreditation: Mark Coles Smith



women knowledge-holders tell it (Lilienthal et al. 2024, pp. 295–298):

“(Anne): [A First Law Story about Doodoodoo a large geothermal activity where a fracking well is planned near this particular sacred site. Importantly how, the serpent that occupies this sacred water hole was a man and took the form of a King Brown Snake] (Grace). *The people wanted him to slow down. You gotta kill him. The King Brown Snake was a tall man person in the Dreamtime. The people said we must kill him, they told the Blue Tongue Lizard (in the form of a man from the Dreamtime) you must kill the King Brown (man), you gotta kill him tonight. Bluetongue (man) bin kill im (did kill) the tall man. And from there and they will put him on the tree when they put him up on the tree.*

(Anne) This was the way burials of significant people happened, the body was placed on a platform in the trees to allow it to decay after which their bones would be gathered for reburial).

(Grace) *All thing you know, fat and thing were melting.* (Anne) The body fat of the King Brown Snake Man fell to the earth and formed water holes, known as mound springs, in particular the sacred geother-

mal activity of the sacred site named Doodoodoo. Doodoodoo is the name of the sound of the geothermal activity from this sacred site).

(Rosie) *That's why you gotta water everywhere in the tree. You can look them up. In the tree you gotta water bubbling hot water. Yeah it's got hot water. In the. And then this side, I think that what a problem? You know. That's where we care about the country. You. Know, yeah. We're careful for that thing”* (Lilienthal et al. 2024).

The proposed drilling near Doodoodoo at Noonkanbah caused great concern about the sacred ancestral sites and places:

“(Grace) *And drilling people come everywhere. (The Elders believe if we drill around this sacred site, it will create earthquakes). Finishing crack from there, that Doodoo doo. Inside that snake, snakes/serpents are associated with living water. It will get angry. Yeah, and he'll crack them open everywhere and they'll go right up everywhere. And the poisoned water go everywhere. Now, that gas, you gotta wake up the bowl of hot (geothermal) water. Then they're gonna kill us”* (Lilienthal et al. 2024).

Another story reinforced this, noting the impacts on water:

“(Grace) You wouldn't want that to happen. Let the water be. Let the water stay in that place, no good. It is a sacred place. For many people, they were telling that story. Same story. Don't let them. Don't let them. Elders don't want the miners to drill this sacred water place. They are worried about the possibility of triggering earthquakes. They want this place to be left alone as it is a sacred place with a story of deep meaning and wisdom” (Lilienthal et al. 2024).

The very real potential for the drilling and other extractive activities was also noted in the senior women's stories, as they drew attention to the way that the river and all the waterways are interconnected, including with the whole living ecosystem:

“(Anne) The Elders' understanding of these tunnels' connectivity to other living water systems is very clear: if we frack near these places it will carry the contamination and poison through underground capillaries, which they call tunnels.

(Grace) There are underground tunnel going up and down you go from Doodoodoo to Jubilee. They (the tunnels) go up and down. That's the snake the underground water? You got a big tunnel there. Can't they (the miners) leave it alone? It's a place for the serpents not for drilling. (The Elders advocate we should not impact on these geothermal living water systems)” (Lilienthal et al. 2024).

These stories are a very powerful and urgent call for free, prior and informed consent and participatory decision-making, to be enacted through an ethical approach, ensuring procedural and distributive justice (Evensen 2016; Schlosberg and Collins 2014). What these stories also tell is the importance of cultural values as part of the fabric of spiritual significance for the river and its ecosystems. Importantly, it shows why this knowledge must be seen and valued as Indigenous science. This science must be included in water planning, extraction, and management, particularly when we are considering groundwater extraction associated with the absence of knowledge and evidence of the recharge rates of these systems.

Words, worlds, and knowledge: Talking and knowing Martuwarra Fitzroy River of Life

There are many dimensions of Yi-Martuwarra people knowing, talking, and being in river country, and these voices speak to deep knowledge of the river in all aspects, including groundwater. Words, languages, and concepts, closely interwoven with deep knowledge and ways of being in the river

country, are the foundations upon which Martuwarra people relate to, and are a part of, the river. The River of Life is the very core of their being, and languages. Knowledge and stories give it meaning for peoples' lives and livelihoods. The river is not just what can be seen, but is all its dimensions, structures, moods, and behaviors. The architecture of the river is also groundwater, deep geology and history, ancient, storied layers, speaking with the voices of the ancestors, guided by First Laws. The scientific/technical knowledge and approaches of hydrogeological activities must be informed by these multi-dimensional contours of culturally significant meanings and values that express Yi-Martuwarra worldviews.

Climate water justice: Intersecting knowledges and narratives

In a broad sense, water governance regimes throughout Australia conform to or reinforce the aforementioned power inequalities (Toussaint 2008). Water governance and regulation are often determined by vested interests, and in that regard, undermine or subjugate Indigenous knowledges, including water knowledges and practices. This paper argues that technologies used for water management and infrastructure have been developed for hundreds or thousands of years by Indigenous people. Indigenous ecological knowledge, which are referred to as Indigenous science, has been ignored, appropriated, or co-opted by dominant groups and governments. This pertains also to Aboriginal guardianship and stewardship of water, including the Martuwarra Fitzroy River (Poelina 2023). We suggest how Indigenous sciences produce water knowledge, in opposition to the more 'abstract', 'objective' and 'computational' approach of hydrology, unsettling the prevailing dominant water governance narratives, and producing 'discomfort' in relations with 'society'. In our alternative vision for water governance, discussed further below, an approach is offered that can provide a critique or counter to the kinds of hydrological computations that overlook people living on country and instead link water to financial institutions, in other words, where 'water flows to money'.

Water rights, power and inequality: Justice and rights

In critiquing a computational, metric-oriented scientific approach to hydrogeological and geothermal activities, disciplines, and knowledge formations, it is essential to foreground water as a human right and also as an Indigenous right. Our critique of the top-down, dominant narrative of the hydrological and hydrogeological discourses attends to the unequal power relations and injustices of water colonialism. In this framework, we look to ways in which our

proposed alternative governance modalities can contribute to recognition of justice and rights for Indigenous peoples in regards to water. Alternative river and water governance models, are suggested to offer ways to decolonize the extractive and exploitative practices that are brought about by the conventional rational-scientific hydrogeological knowledge. Our interventions, founded upon First Laws and Aboriginal cosmologies, aim to unsettle, and provide a counterpoint to the embedded and systemic injustices inherent in the prevailing extractive water colonialism (RiverOfLife et al. 2023).

Developing the alternative governance model necessitates teasing out the complex intersections between climate change, climate and environment justice, and rights. The models for alternative governance, detailed below, are founded upon notions of distributive, regenerative and procedural justice, all of which are underpinned by key international rights standards. The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in particular, provides for water rights, as part of the fundamental right to self-determination that is the cornerstone for this crucial instrument. The concepts of distributive and procedural justice also go to ideas about fairness, equity and ethical standards in regard to unjust practices, all of which are the essential elements in propounding a decolonized water justice approach (RiverOfLife et al. 2023). While distributive justice refers to the ways in which outcomes (in planning, policy and administration, for example) are distributed within society and across diverse groups and sectors, procedural justice tends to be more concerned with ‘fairness in and legitimacy of planning and decision-making processes’ (Jafino et al. 2021).

These matters of justice are critical in discussions of water governance, in the context of water colonialism, as pointed out by RiverOfLife et al. (2021):

“Attention to water governance is warranted because water issues are never ‘just’ about access to water volumes. Water is contested on multiple levels, from access to rules to societal discourses.... Decisions about water have profound impacts on peoples’ lives. Water justice depends on the fairness of water governance processes and outcomes.... In Australia, a major contributor to injustice is a governance system based on water colonialism”.

The persistence of water colonialism and the call for justice is not only situated in the aqueous domain but is connected to wide-ranging forms of injustice resulting from the long (and continuing) colonial/imperial project. At the heart of this is an urgent call for self-determination, as highlighted by Robison et al (2018):

“Indigenous Peoples are struggling for water justice across the globe. These struggles stem from centu-

ries-long, ongoing colonial legacies and hold profound significance for Indigenous Peoples' socio-economic development, cultural identity, and political autonomy and external relations within nation-states. Ultimately, Indigenous Peoples' right to self-determination is implicated”.

The UNDRIP, as mentioned, is an essential foundation upon which the call for Indigenous water justice as part of self-determination rights is situated. It enunciates key provisions for recognition of water rights, and for partnerships (e.g., nation-states, and sectors of civil society) in realizing these rights. The UNDRIP calls, for example, for recognition of Indigenous peoples’ rights to “control develop, own, and use water they possess by reason of traditional use or ownership or other means of acquisition” (UN UNDRIP 2007, Art 26(2)). In this instrument, nation-states have ‘reciprocal obligations’ to provide ‘legal recognition and protection for such water’ (UN UNDRIP 2007, Art 26(3) and 27).

The call for water justice can be situated within the wider frame of climate justice, which “focuses on local impacts and experience, inequitable vulnerabilities, the importance of community voice, and demands for community sovereignty and functioning” (Schlosberg and Collins 2014). Under the umbrella of climate justice (Harlan et al. 2015), there is a need to have regard for inequities in the ways that risk management and governmental protections are distributed as matters of distributive justice (Schlosberg and Collins 2014; Chandani 2007). At the same time, there are also systematic challenges in ensuring ‘procedural justice’, which goes to racialized issues around exclusion, disrespect, lack of capacity and recognition in participation, and other such invidious practices. Schlosberg and Collins (2014) set out some of these issues:

“As with environmental justice in general, a climate justice-based conception of just adaptation means looking beyond distributive conceptions of justice. While inequity is central, the environmental justice focus on adaptation is thoroughly engaged with particular issues of participation, impacts on culture, and the capabilities communities need to function. A demand for procedural justice, for example, remains constant in the turn from prevention at the international level to adaptation at the local. Every set of climate justice principles mirrors the call in environmental justice movements for participatory justice, and this insistence on inclusion is no less in the case of adaptation”

It is worth noting that a concept of ‘just adaptation’ or similar is supported by various international processes, agendas and standards, including the ‘loss and damage’

agenda of the United Nations Framework on Climate Change (UNFCCC).

As well as distributive and procedural justice, restorative justice also needs to be considered. This has been articulated by Loughrey et al. (2024) in the context of the 2017 Uluru Statement from the Heart, and in the campaign for what became, unfortunately, an unsuccessful national referendum vote for an Indigenous Voice to Parliament. In a statement on water justice, these authors indicated how restorative justice could be a central plank in a rights-based approach to decolonizing water:

“An important step in restorative justice is the determination of a ‘fair share’ of water, which could, if First Peoples wish, be part of water reform.... But this cannot be a singular path and should embrace multiple approaches leading to restorative justice. And along this journey there must be truth-telling.

Embracing Indigenous ways of knowing which recognize Indigenous natural law, stories, lore, and customs provide important steps towards restorative justice. This journey is one where wrongs are made transparent and where, following restorative justice, all can walk together towards a sustainable, respectful, and just water future”

(Loughrey et al. 2024).

All these forms of justice – distributive, procedural, and restorative, are at the heart of the recognition of Indigenous water rights in the context of extractive activities. As discussed above, there is also a clear relationship between climate emergency and rights to water. Hence, climate justice needs to be part of the frame for a serious critique. Water must be understood as a human right, not only as a resource (for extractive and economic gains). However, there is a global trend to commercialize, privatize, and commodify water and water resources. This has the effect of underlining, or diminishing water rights and water justice. Studies have demonstrated the growing inequality of power relations in regard to water access and rights. The Australian Murray-Darling Basin is a case in point. Additionally, the particular modalities of water governance at local and regional levels have a vital role to play in climate adaptation strategies. This is explored, for example, by Samnakay et al. (2024). There is a widening gap in the international system between water-rich and water-poor communities. Ownership of water and its private use by extractive industries, including mining, industrial agriculture and hydropower, pose an existential threat to Indigenous communities and minority groups worldwide (Poelina 2023).

In keeping with distributive and procedural justice, Anne Poelina and her people, as citizens, have a right to life, including a right to a clean and healthful environment. This right of every world citizen was recently affirmed by

the United Nations Human Rights Council in a resolution (48/13) on October 8, 2021, “*recognizing that people everywhere have a fundamental human right to a safe, clean, healthy and sustainable environment*” (UN HRC/RES/48/13 2021). This was a historic resolution that has the potential to improve the lives of everyone on the planet.

Therefore, any development that will impact the land, water, people, and environment of the Martuwarra Fitzroy River Catchment, inclusive of atmosphere and underground water and geological systems, must be developed by the state of Western Australia as “ecologically sustainable development” (ESD), in accordance with this important mandatory consideration. ESD was incorporated into all state, territory, and federal environmental planning laws across Australia following the Rio Declaration 1992.

River governance: An alternative vision

The need for a vision of an alternative mode of governance for the river challenges the structural inequalities and injustices inherent in the survey and mining of water resources. We are still in the era of colonialism, including water colonialism; the surveying, fracking and other extractive activities in the Kimberley. These practices have critically harmful impacts on the region and on Aboriginal communities, providing a degree of urgency (Poelina et al. 2019; Taylor et al. 2017). These injustices are exacerbated in the context of the current human-induced climate crisis, especially given its impacts on our precious river and environs.

Our approach and vision of alternative ways of governance for the Martuwarra Fitzroy River and region are based on the Wunan First Law, which is one element that provides a framework within which we advocate for a self-regulating bio-regional governance framework (RiverOfLife et al. 2021). The establishment of the Martuwarra Fitzroy River Council and the request by Elder Butcher Wise to stand with one mind and one voice are also significant (Poelina et al. 2019).

An alternative approach to water governance welds together climate justice, ‘climate water justice’, and ethical consent mechanisms and processes, to develop a bioregional framework that ensures procedural and distributive justice. Such models are informed by deeply embedded human-water relationships, and Indigenous knowledges and First Laws, in order to understand, and therefore to offer a critique of the cumulative impacts of groundwater depletion or geothermal resource exploitation. The current climate crisis is exacerbating the problems facing Kimberley Aboriginal communities in securing rights and access to water. A climate and environmental justice model must ensure that attention is paid to dialogue, ethics and free prior and informed consent (Schlosberg and Collins 2014). As we shift towards, or beyond the tipping point, we hope it is not too

late for Indigenous peoples to achieve real and lasting climate and environmental justice (Whyte 2016).

In our vision for alternative forms of water governance, we can look to a multi-pronged approach. At the international level, there are opportunities to develop within domestic jurisdictions, specific self-determining Indigenous governance entities, provided in the 2010 Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity. The concept of an Indigenous ‘competent authority’ might include specific forms of Indigenous governance or regulatory bodies for biological resources and Indigenous knowledge, which serve as the foundation for water governance. An Indigenous competent authority is one of several options that have the potential to be incorporated in the governance of Martuwarra Fitzroy River

Our vision for alternative modes of water governance also incorporates rights-based approaches, which can embrace what has been articulated in various ways, such as ‘biocultural rights’ (Apgar 2017). These are a form of group, or collective rights which can, according to some interpretations, make important connections between people, in what is framed as ‘peoplehood’, and ecosystems (Bavikatte and Robinson 2011; Bavikatte 2014). In the literature on Indigenous rights, one view suggests that the concept of ‘peoplehood’ is “... *integrally linked to the rights to stewardship of their lands and concomitant traditional knowledge through a complex system of customary use rights and fiduciary duties*” (Bavikatte and Robinson 2011). Biocultural rights are a formulation that has the potential to take a valuable role in the thinking around Indigenous governance. Alternative governance approaches may include, among many types, biopolitical governance, or bio-governance, polycentric governance, or cultural governance. In a ‘biopolitical governance’ frame, attention can be given to the complexities of an ethical and caring governance of nature and ecosystems. It might be seen as a “... *mode of governing nature with the objective of achieving ‘overall states of equilibration or regularity’ in relation to its bio-ecological processes*” (De Lucia 2017). Polycentric governance models comprise multiple centers, or nodes of decision-making or authority, which function as integrated systems (Ostrom 2010). In an Australian context, a polycentric model is discussed by Turnbull et al. (2023) as one that can be envisaged as a locally based form that can inform and underpin Indigenous self-governance to facilitate and safeguard the wellbeing of humanity and natural ecosystems.

Other types of Indigenous governance can be formed on the basis of specific cultural aspects, in what might be termed ‘bicultural governance’. This term is used in the context of the governance of the Martuwarra Fitzroy River in the Kimberley region of West Australia, to refer to “*a complex,*

adaptive and continuing contemporary practice” (RiverOfLife et al. 2021). It is used to “*delineate between First Peoples’ governance and Australian settler state water governance*” and engages with the terms ‘culture’ and ‘cultural’ as these “*are becoming synonymous with First Peoples’ culture, including Law, language, institutions and ontologies*” (RiverOfLife et al. 2021). In the context of this usage, another way of describing ‘bicultural governance’ could be ‘Aboriginal governance’. When contemplating the idea of dialogical engagement and benefit-sharing of biological and genetic resources and Indigenous knowledge, it is useful to consider joining cultural governance and Australian settler governance to form ‘co-governance’ as a bioregional model (RiverOfLife et al. 2021).

Overall, we envisage an alternative mode of governance could be fashioned from various combinations of the kinds mentioned here. Various approaches to, and models for alternative modes of governance, including polycentric, bioregional, and Indigenous, are discussed in Turnbull et al. (2023), RiverOfLife et al. (2021) De Lucia (2017), and Ostrom (2010). The resulting governance modality would offer a counter to the prevailing scientific-technological forms of governance underpinned by the dominant hydrogeological narratives informed by the structural inequalities of extractive and destructive water colonialism. Our vision foregrounds an Indigenous-cultural values frame founded upon principles of ethics and just and fair sustainability.

Conclusions

In this paper, very different narratives for extractive interests in the abundant hydro-geothermal resources of the Martuwarra Fitzroy River region have been woven together. Yi-Martuwarra stories voice the deeply embedded cultural and sacred values of the river, including groundwater. The importance of the intergenerational transfer of cultural knowledge and the lived experiences have been discussed through the stories of the Elders, who recall the fracking, drilling, survey and other activities by Amax Petroleum in the Noonkanbah region during the 1980s. Their stories powerfully show how First Laws and ancestral Dreamings inscribe the country with meanings and values that are antithetical to the scientific-technical exploitative narratives that drive the developers. At the same time, the complex, entangled knowledge-formation of the Martuwarra knowledge has been shown to contribute towards the production of scientific hydrogeological knowledge and practice. Weaving these different, entangled narratives together, it has been shown how an alternative vision might be advocated for a bio-regional governance model that is inclusive,

just, and economically and culturally empowering. As Poelina (2023) states:

“Our Dream is to have a bicultural bioregional governance framework inclusive of regional Indigenous Nations, and the wider public interest groups working together to understand risks but also opportunities for sustainable lifeways and livelihoods. We are coming together to inform local government engagement as part of a wider stakeholder group of business, industry and community partners. This is a model for cooperation and informed decision-making that can guarantee water justice through procedural and distributive justice for all”.

This paper points to the need for cooperation and unity, and the collective governance necessary to ensure procedural and distributive justice and the greater good of all, including the non-human kin of our broader family. Today, there is an opportunity to consider a biocultural bioregional framework through Australia’s nature reserve system of bioregions. The Kimberley model incorporates all of the nations within the catchment, as well as fellow Australians, local government and all stakeholders. The importance of building trust and an evidence-based approach using both Western and Indigenous science, the latter’s knowledge accrued over tens of thousands of years of lived experience, including the last Ice Age, great floods, and changing cultural landscapes. This ancient wisdom is critical to the water planning and decision-making needed to better understand the groundwater systems within the Martuwarra Fitzroy River Catchment.

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Data availability All data and materials will be provided on request.

Declarations

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