

Living water: groundwater and wetlands in Gngangara, Noongar boodjar

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Abstract

Different languages, knowledge systems and ways of knowing impact upon shared understandings of place across and within landscapes. In this article we illustrate ways in which Noongar and English language-based understandings of groundwater and wetland interactions can inform a third space. Noongar knowledges recognise deep interdependences across social, linguistic, ecological, physical and spiritual domains, while English ways of knowing highlight separations and abstractions such as those between people and nature, and spirit and matter. The English language assumes a linear sense of time in which the past is always behind the present, where going forward is associated with progress. Noongar language acknowledges cycles of time, enabling the heroic characters and ancestors of the past to participate in a 'long now', and continue to impress upon people the need to care through the maintenance of storied and sacred places, an example of a living mythos. Using Latour's social theory (2017), we show the instability of separations, particularly between people and nature, due to their multiple interrelationships. Aboriginal ways of addressing wetlands as places in a cosmology can be used by all visitors and residents, to nurture a sense of respect, care and familiarity. We recommend learning local Aboriginal languages and place-based knowledges in environmental sciences at all levels, and in all schools to facilitate this process.

Introduction

Contemporary approaches to natural resource management recognize, although somewhat partially, Indigenous knowledges, local knowledge, and western science as contributors to understanding living systems of land, water and people. In this paper we examine one such system, the Gngangara groundwater system, comprising the northern parts of the city of Perth and beyond, in southwestern Australia.

Using Noongar language interpretation we learn that Noongar *bidier* (knowledge holders or pathfinders) have deep knowledge of a relational worldview of living and learning. *Moort* – family, socio-cultural and place relationships – including everyone and everything – are held in a high regard that acknowledges the spirit of place, a concept we develop throughout the paper. From this comes *boodjar*, a relationship with Country⁴ that can develop alongside a strong sense of place if the emotional and spiritual connection to place is valued. This means that in caring for Country, in this case the Gngangara groundwater ecosystems, humans are not separate from the world/earth/life, but are a part of it. However, at the same time, we are not passive, but active agents obliged to care

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for country. Here the emphasis is on 'working with' rather than 'control over' ecosystems. Through Noongar language, respect is awarded to the complex, animate, place-based energies and forces. Humans implicitly play a role, told with the power of story. The term *katitjiny* means knowledge, thinking about knowledge and the respectful relationships of deep listening to the voices of others, including stories, enabling reflection and reflexivity. There is a meta-cognitive element, involving ongoing process discussion and renewal.

We intend for our work to contribute to the process of Noongar cultural reclamation, and support the rebuilding of cultural-spiritual relationships to the natural world, as a cosmology. This approach lends itself well to the range of Gngangara groundwater ecosystems in particular, being place-based but scaled at the catchment level, and otherwise hidden underground despite playing a fundamental role in the lives of Western Australians.

Methods

Starting with a western scientific perspective, and by identifying, using and interpreting Indigenous place names, most of which are incorporated into common parlance, we set out to determine whether a combination of Aboriginal and Western sciences can produce a more complete explanation of a living system. Our hypothesis is that in doing so, we might be able to use this approach to heal damages caused by continuing colonial practices.

Our methodology, referred to by Stocker et al.⁵ as *katitjiny bidi* (knowledge trail), aims to enliven Noongar stories, and therefore *boodjar* (Country) and all people of southwestern Australia – Noongar people, descendants of settlers and newcomers. To do this, we further develop the concept of the third space: the relational field of Noongar/Western knowledge convergence, and we aim to contribute to reciprocal colonisation. Both these concepts are pluralistic, multi-polar endeavour of both-ways learning and change; an undertaking that acknowledges and celebrates Noongar active agency in bringing about settler and newcomer social change.⁶

At the outset, it is important to recognise that we intend to make no essentialist or romantic claims about Aboriginal people and their traditional knowledges⁷. We are a research partnership whose work is supported by contemporary Noongar language interpretation – particularly through re-interpretation of settler dictionaries. Our work is also supported with documents published by Noongar authors and oral accounts, drawing on their "*koorliny yirra* Noongar (growing up Noongar), *katijin* Noongar *wangkiny* (learning to speak the language), *katijin* Noongar (interpreting the evidence using Noongar ways of thinking)"⁸. In this paper we weave together a variety of perspectives, including narrative, scientific, historic and language interpretation.

The Gngangara groundwater system

The Gngangara groundwater system occurs in a sandy coastal plain bounded by conspicuous landscape features which include an escarpment in the east and the Indian Ocean in the west, and the lower reaches of two different river systems, one to the north and one to the south. The groundwater system is currently managed by the Western Australian government; more than half of the metropolitan area of the city of Perth (population over 2 million) is situated on top of (in the catchment of) the Gngangara groundwater system, which provides the city's population with more than half of its water for domestic consumption (Figure 1). Even so, no single jurisdictional area encompasses the entirety of the groundwater system.

In contrast, and to emphasize a common feature of Aboriginal societies where cultural units and drainage boundaries regularly coincide(d)⁹, most of what is now known as the Gnangara groundwater system, possibly as far as Moore River, may have corresponded with the Noongar Wadjuk district known as 'Mooro country', or Yellagonga's territory (as told to Robert Lyon by Yagan, son of the tribal elder Midgegooroo around the time of colonisation¹⁰).

The Gnangara groundwater system is located on the Swan Coastal Plain, a bioregion in southwestern Australia that lies to the west of a significant linear escarpment known as the Darling Fault. The Swan Coastal Plain is largely covered by sandy wind-blown sediments which may be up to 110 m thick¹¹. These sands have been deposited relatively recently, over the last million years or so. Their high permeability means that rainfall on the Swan Coastal Plain tends to infiltrate locally, and this has two important consequences. One is that the plain lacks surface drainage like creeks; rather, most of the water goes immediately underground, and the only fresh surface water in the region is in wetlands in the depressions between the longitudinal dunes. So these wetlands are surface expressions of a shallow water table, and for these reasons the groundwater system is referred to as an 'unconfined aquifer', and the Swan Coastal Plain is regarded as a vast wetland bioregion, where ecosystems have a so-called 'dependence' on groundwater. The second consequence is graphically demonstrated by the elevated dunes at the highest points of the Gnangara system, where the unconfined water table is mounded, and from here it flows radially towards the coast, rivers and estuaries which are the boundaries of the system¹².

Beneath the sandy sediments of the Swan Coastal Plain lie a series of vertically interconnected sedimentary layers, kilometres thick, resulting from sediments filling up the Perth Basin over around the last one hundred million years. Each sedimentary layer is water-filled. So, for the Gnangara system, rainfall recharges the groundwater mound in the top unconfined sands, each subsequent geological layer is to a certain degree, and in certain places, recharged by the one above it¹³. In this sense it is one hydrological unit even though it is composed of a vertical sequence of interconnected but geologically distinct aquifers¹⁴.

The people of Perth have overused the Gnangara Mound to the extent that it is in a serious state of deficit¹⁵, and the system as 'out of balance', where more water is being taken than is currently being replaced¹⁶. There is a suggestion that overdrawing from deeper aquifers has contributed to this by creating a negative pressure and drawing down water from layers on top. Managing the overconsumption of this resource in the face of climate change, with its projected rainfall declines, is a considerable challenge.

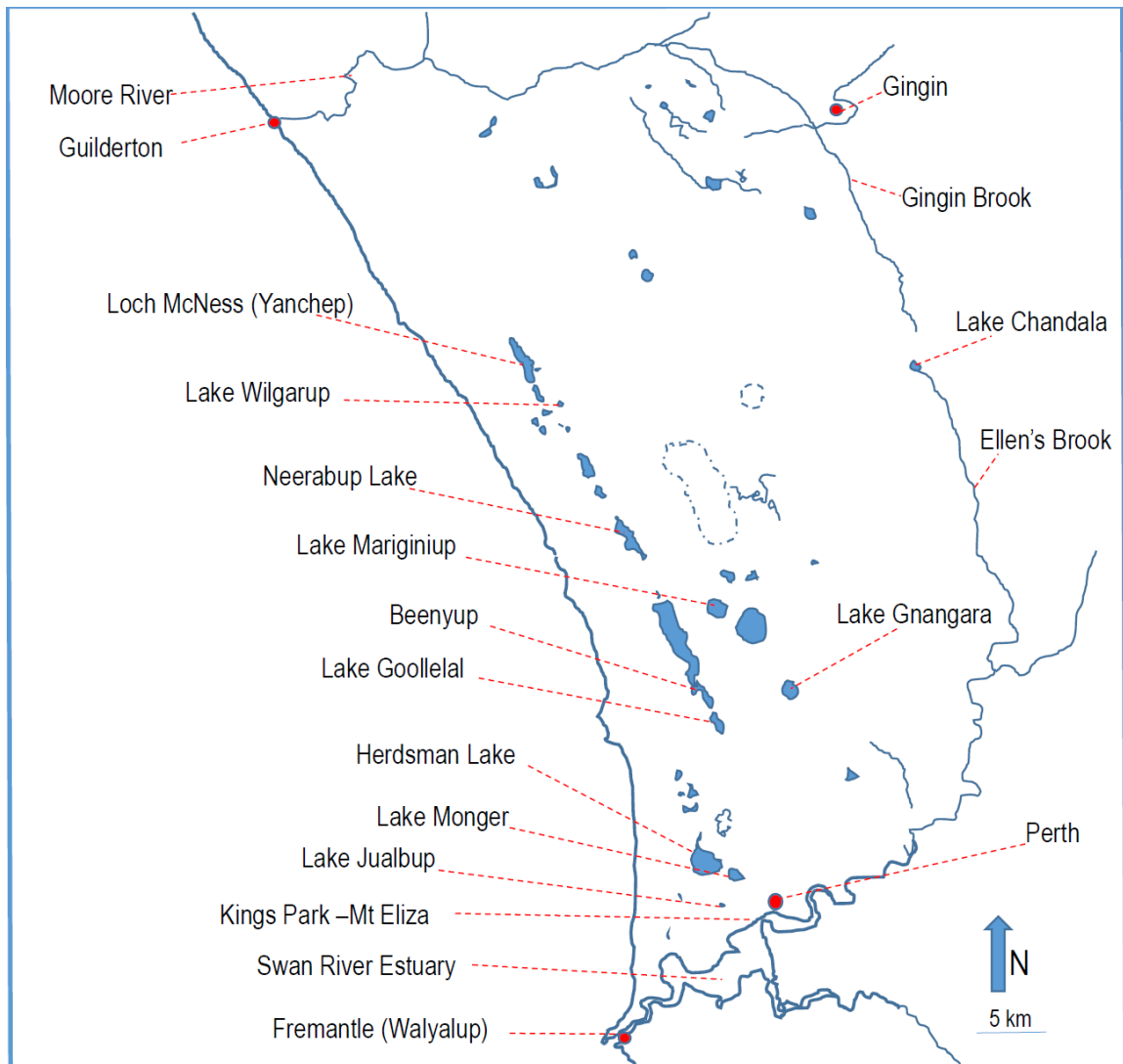


Figure 1: The wetlands of the Gnangara groundwater system showing commonly regarded place names used in the text. The system is bounded by the palusplains at the foot slopes of the Darling Scarp which runs north-south immediately to the east), the Indian Ocean to the west, the Swan River Estuary to the south, and Moore River (with Guilderton at the mouth) to the north.

Another set of narratives are established by tracking the trails of *Waugal*, the rainbow serpent, who created wetlands, leaving behind *gabbidordok*, living water¹⁷, essence of a living, storied landscape: *boodjar wangen*¹⁸.

To the Nyoongahs of the south-west of Western Australia, the Rainbow Serpent created their universe. It was responsible for forming the topography of the land. As it wended its way over the countryside, its body created the curves and contours of the hills and gullies, and the rivers, lakes and springs. As it moved over the earth, its scales scraped off to become the lush, green forests and rolling woodlands of the south-west, covered with wildflowers in all the colours of the rainbow. The Rainbow Serpent created the Nyoongah people to care for the land and the wildlife, and when its work was finished, it delegated the Wagyl (a mythical serpent) to be the keeper of the fresh water sources. The Wagyl, a lesser, but nonetheless powerful, deity, protected the rivers, lakes and springs and the wildlife which

abounded around, and in, these areas. It had to ensure the people, being humans, did not become greedy and deplete the animal, bird and marine life, for every living thing had the right to regenerate, as did the humans. The Wagyl and the people worked together to look after the environment. The Nyoongahs respected the Wagyl, heeded its warnings and lived in harmony with nature. In essence, the Rainbow Serpent was the creator, the Wagyl was the keeper of the rivers, lakes and springs, and the Nyoongah people were the guardians of the land. That was the Creation.¹⁹

According to Goode and Associates²⁰, the continuous chain of lakes from Moore River to Mandurah and in fact all the rivers, lakes and wetlands in the Perth region, were believed to have been created by the Waugal. And there are acknowledgements of the underground:

At a deeper level Waugal mythology was a metaphor that emphasised the pre-scientific mysteries of the rivers, water sources and the landscape. It also explained how water moved throughout the Swan Coastal Plain as a system of underground streams interlinking wetlands to the rivers and ocean²¹

And

At times this great serpent went under the ground and came up again forming the area where there would be lakes...²²

Once finished (creating) he went to an underwater cave. *Waugal*²³ resides in deeper holes, and there are signs of the *Waugal* everywhere: "The *Waugal* also joins up with wetlands such as Herdsman Lake and Lake Monger, and resides deep beneath underground springs..."²⁴

When the great *Waugal* created the *boodja*, he ensured that there was *wirrin* or spirits to look after the land and all that it encompassed. Some places such as the *karda* (hills) and *ngamar* (waterholes), *boya* (rocks), *bilya/beelier* (rivers) and *boorn* (trees) were created as sacred sites and hold *wirn* (spirits), both *wara/mambaritj* (bad) and *kwop* (good).²⁵

The breadth and depth of attributions to the *Waugal* were summed up:

The Waugal is not just a mythic serpent, an Australian version of the Loch Ness Monster. The Waugal is not just a totemic ancestor. The Waugal is not just a spiritual being, a semi deity. The Waugal is indeed all of these but is, more fundamentally, a personification, or perhaps more correctly animalisation, of the vital force of running water ... As such also, the question does this permanent river (or creek, or spring or other water source) have (or belong to, or be associated with) a Waugal (or the Waugal) becomes, from an Aboriginal viewpoint, meaningless and condescending. The presence of living water bespeaks Waugal immanence.²⁶

These two accounts tell of the creation of this place and our human role in it, and form part of the character of the plains. One tells the story of geomorphology and hydrology and sedimentary processes over time, the institutional arrangements and their failure, and what the failure might mean. The other bares its cosmology of humanity, tells the importance of stewardship and care and respect, and introduces the *Waugal* as the creator and its intimate association with where water lies and where it resides, ensuring ongoing care.

These stories belong to different knowledges and ways of knowing, and due to problems with English language, are seen by English language speakers as

incommensurate and unmeasurable in relation to one another. In the following we seek to examine the ways that these types of knowing can actually inform one another.

Language and Worldview

Here we begin our construction of the third space, where Noongar and Western knowledges converge. This takes an approach similar to that of interdisciplinarity – showing links between bodies of knowledge that facilitate development of a coordinated whole. We describe the vital functions of language and worldview in understanding place-relationships. We develop these with dual understandings of society and nature first. Following this, we use non-dualistic descriptions in which more-than-human creatures (and the Earth itself) can be seen to be agential, animated, enlivened: actants²⁷ in micro-macro networks of relationships.

Language influences the ways in which people relate to their places. Knowledge of this simple fact can enable English speakers to begin to understand a Noongar worldview, which frames Noongar conceptions of places. Noongar traditionally understand themselves by their relationships and obligations to their *kurduboodjar*, or heartlands. In this way, through socio-ecological classificatory systems, more-than-human species also have commitments and obligations to people, other species and each other as well. Noongar tradition comprises active participation in the languages of landscape.

English, however, with terminology such as wilderness, environment or even ecology, can discursively imply separation of people from places (or systems without people). For instance in Noongar language there is no word for *nature*; the word ‘*natural*’ as a descriptor is problematic because it implies a dualistic ‘non-natural’, a cultural and constructed, and more highly valued, part of our surroundings for which humans are responsible, further emphasizing and reinforcing disconnections with our surroundings. The English language is replete with words of abstraction, literally taking its speakers out of the relationships of earth, health and life. George Seddon recognised this in his book on Sense of Place, actually about the cities of Perth and Fremantle on the Swan Coastal Plain:

Our language is poor in words of place. ‘Parochial’ and ‘provincial’ are both derogatory, although there is nothing wrong with parochialism if your parish is a good one. These words express the expansionist faith that has driven Europeans for the last 300 years. We have the word ‘timely’ but there is no equivalent ‘placely’. ‘Topical’ literally means ‘pertaining to place’ but this use today persists only on labels of ointments for topical application. By extension from ‘the topics of the day’, ‘topical’ has come to mean ‘timely’. The drive of much of our technology is to obliterate distinctions of place.²⁸

Discourses embed values and attitudes in this way. In recent times aquatic ecologists use the concept of ecosystem services to humans and the biosphere, illustrating the profound interconnectedness between people, place and planet. Nonetheless mainstream Australian society maintains the linguistically-based people-place separation. This separation is Australian hegemonic discourse, that is, it is ‘common sense’, to many speakers of English as their first language, and underpins a limited, narrow, dualistic, competitive worldview or cognitive orientation.

Latour’s new materialist cultural theories reveal the role of English language in maintaining these artificially-maintained separations²⁹. In fact Latour points out that most definitions of ‘human’ distinguish human from nature – which he demonstrates is a false nature/culture division. To the contrary, because of their many linkages, the separation is unstable because each side exists within multiple relations with the other. There are a

great many distributed features, and in fact each exists as one half of the same concept³⁰, having a common core that distributes differences between them. In this way it can be understood not as a dualism, but as a monism. Along with many other dualisms, there is an astonishing connivance between these agencies which have been understood by English speakers to be conceptually discrete. Latour argues that these separations have caused people of the west to ignore warnings about climate change over a period of three or more decades, illustrating a madness, a “profound mutation in our relation to the world”.³¹ One cure for this madness, he proposes, is to use a language that does not see these differences as oppositional.

Once these dualisms are removed, the Earth can appear as it really is: animated “by countless forms of agents”³². It is neither inanimate nor inert as it has heretofore been represented in English. This conceptual monism enables some basic understanding by English speakers of a phusimorphic notion of ‘nature-culture’. Using the work of Serres, Latour says:

...in the last analysis, we indeed speak the language of the world, provided that we learn to translate “the animist, religious, or mathematical versions” from one to another. Translation, Serres’s great project, becomes the way of understanding by what we are attached and on what we depend. If we become capable of translating then the laws of nature begin to have a spirit³³

Similarly, there seems little point separating the worlds of the spirits and matter because when agency is distributed among the consequences, a new material is visible. Thus, jettisoning the idea of a separate nature (along with its theology and politics), a form of causalist narrative closely resembles creationist stories and the whole series of what follows³⁴. This notion of the ‘nature-culture’ is a practical third way – supported in Western science and Noongar *katitjiny*, as we show below.

Noongar language-based relationships

To more deeply understand the idea of place as relationship, in this section we use Noongar language to explain a traditional Noongar worldview, characterised by *boodjar* as nature-culture and *gabbidordok* as living water.

In Noongar tradition and language, Noongar people are known by their homelands, for example *derbalung* are estuary people, *bilgur* are river people, and *buyungur* are people of stoney ground or stoney hills³⁵. There are eight separate, equal socio-ecological classifications into which everyone including more-than-human species are born. Everyone and all species are classified into one of two halves or moieties: *manitjmat* or *wardangmat*, each with four sub-sections.

Similarly, everyone and all species are male or female, including plants. Each group has their own allegiances and identities, but all are understood to be reciprocally dependent. In this way because more-than-human beings – such as kangaroos or trees – also have kinship status, they are also the providers and recipients of respect, responsibility and care. For example, *borungur* means totemic ancestor or ‘in relation to’, or second brother. This means a totem is treated in the same way as the duty of care towards one another in a familiar way, like a brother. Therefore kinship ties people to place through reciprocal familiarities, obligation and care³⁶. That is, one’s place and all its species, waterways and entities are family. This Noongar-place relationship is called *Kurduboodjar*, meaning both heartlands and love of place³⁷.

Due to limitations of English vocabulary, a Noongar holistic place-relationship is tricky to translate into English. For instance *boodjar* is often translated as land or Country,

an English term that is insufficient. Due to kinship relationships, *boodjar* also means ecosystem; comprising land forms, food and water sources, people, law, narratives, spirits and other entities. Similarly its extension *boodjari* means pregnant, full of Life. Using Aboriginal perspectives, 'Country' has been described as 'nourishing terrain'³⁸, in the sense that a pregnant landscape is a nurturing, creative, fertile, productive human environment³⁹. It is a non-dualistic nature-culture (hereafter referred to as *boodjar*), characterised by rhythms of diurnal, seasonal and annual cycles of responsibility and place-based obligation, along with social and metaphysical responsibilities. This place-relationship describes and localises the notion of nature-culture – a third way, common to both Noongar and Western knowledge fields.

Narratives based on deep understandings about the significance of water are central to *boodjar*. We use the term: 'long now'⁴⁰ to describe a cyclical, rhythmical sense of time in which elements and characters of the past (*kura*), the present (*yeyi*) and the future (*burdawan*) are all enfolded here in the now (*yeyi*), yielding an expanded, continuing present with an interconnected past and future; a concept fundamental to the *kundaam*, the Noongar belief system. Knowledge, respect and care for water, waterways and wetlands are of immense significance in the dry southwestern corner of the continent.

***Katitjiny Bidi* (Knowledge Trail)**

We use the *katitjiny bidi* (knowledge trail) methodology⁴¹, which aims to enliven Noongar stories, and therefore *boodjar*, along with all people of the South West – Noongar people, descendants of settlers and newcomers – to whom this responsibility now passes. Using Latour's work⁴², we see it is inane to separate worlds of spirit and matter, because agency is distributed among the effects. Similarly, dissolving the English language idea of a separate nature enables a new understanding by English first language speakers to be derived from Noongar language.

Right across Australia water is part of the sacred geography of people's homelands. ... 'Living water' is the term frequently used to describe permanent waters. It conveys the sense of water having its own life, and also of offering life to others...⁴³

Place names offer a way to re-enliven country, so that "...country speaks to us about its history"⁴⁴. Most wetlands on the groundwater system have Noongar names, or Europeanizations of them, and across the catchment some can be shown to depict wetlands as connected up, as routes for moving through the landscape, the type of water found, as food warehouses, and as cosmology and significant events, including stories of *kura* (long time ago) and the *nyitiny* (cold time, creation period).

Seasonal movements for pre-colonial times occurred between the alluvial systems in spring and autumn, the eastern hills in winter and the western wetlands in summer⁴⁵. For the alluvial systems east on the Gngangara groundwater system movements of family groups occurred along *Gynning*, or Ellen's Brook⁴⁶. We understand *Gynning* as a place name meaning 'foot here' or pathway, extending north to Lake *Chandala* (the place name *jen - dar - ala*, or *jen - nidga - ala* can be interpreted as 'this here is the place of the foot track') to the town of *Gingin* (meaning footprints) and to Moore River (*Gynngoord* from Robert Menli Lyon 1833⁴⁷; a place name meaning pathways to my lover/husband/wife). The inclusion of place names with feet (*jen*, *gyn*, *gin* and *chan*) make clear a walking route. Other interpretations from Moore River point differently: the locality of "Mogumber"⁴⁸ may well be from *Moor koombar* - literally "Big part of the river"⁴⁹, actually the river pools

of the Moore River ... “There’s pools along there where you don’t ... you don’t go in there at all. You’re comin’ back to the kaalip for the Wakal”⁵⁰.

Another north-south *bidi* (pathway) was from the mouth of Moore River to Yanchep and to *Galup*, or Lake Monger⁵¹, literally the place of home or the hearth, encompassing chains of productive wetland systems⁵². Place names indicate the use of wetlands as sources of food. For example Yanchep *janjidi* - *up* typha place; *yandjidi* is the name given to *Typha domingensis* – the bull rush⁵³. A swamp called Beenyp (bee - ny - up) literally means digging this location, Lake Mariginiup (*mar* - *marin* - *gin* - *ni* - up) means the location of vegetables (gained by hand and foot). Again, place names refer to travel signposts like Lake Goollelal (*gool* - *lel* - *al*; to travel on or by or hereabouts). Elsewhere on this route place names refer to locations of important materials like Lake Wilgarup (*wil* - *gar* - up; location of the ochre hole), or indicate a character of water like Neerabup Lake (*ni* - *yearer* - *gab* - *bi* - up; this rising water place).

These routes and place names were important in a dry season landscape where knowing the location of food and water was essential. There are very few habitable sites in the coastal dunes or coastal limestone on the western side of this linear wetland series, rather most of the sites lay around the lakes and swamps of the coastal sandplain⁵⁴. The eastern *Gyning* (route) mentioned above was along the productive alluvial belt. This pattern is reflected in the ethnohistorical sources regarding subsistence patterns⁵⁵. Reed rhizomes in sand plain swamps, and yams in alluvial deposits and gravel beds, were major staples, while coastal areas, littoral and forest resources were less frequently exploited.

The place name “Gnangara” could have a literal meaning from *Ngang* (sun, mother) and either *gara* (hole) or *ngura* (small lake or small basin of water). The following narrative explains this:

The three women and the flood. An additional narrative was recorded by a Nyungar elder and he illustrated the narrative with a painting he had previously completed. According to the narrative, the mythical three women were the ancestresses of the people that occupied the Swan Coastal Plain; they ‘set up the original families’. The women floated down the Helena River valley to the Perth area on *balga* (grass trees) in a huge flood, alternatively described as a tsunami, in the Dreamtime. The women set up camp and then spread out into the country around the Swan River. The flood was caused by the melting of the ice by the Sun [*nganga/ngangaru*] because of some wrongdoing contrary to Customary Law. A piece of the sun fell off and according to this version made Lake Gnangara [Gnangara] and evidence of this can still be seen at the northern end of the lake.⁵⁶

A similar general narrative about a primordial flood which followed the *Nyitiny* was given by Bates⁵⁷ but was not related specifically to Lake Gnangara. As a whole the story these place names create highlights the centrality of *gabbidordok*, living water, to the well-being of the ecosystem, including the Noongar people whose stories and lives nurtured and sustained it.

In the section above we described *Boodjar* as bringing spirit and matter together. For instance *waug* or *waugar*, means soul, spirit or breath⁵⁸. *Waug* is a version of *waugal* – a concept that has been interpreted in multiple ways, including the idea of the imaginary winged rainbow serpent or monster who lives in deep water⁵⁹. The concept refers to a highly powerful energy, which was – and still is – a subject of extremely deep respect and reverence. The relationship between people’s *waug* – soul, spirit or breath – and *waugal*, the powerful, vital dynamism of *Boodjar* – explains the deep interconnection between the health of people and ecosystem health through *gabbidordok*. This notion describes place and waterways as having a living, animated nature – a spirit of place.

The Waugal is associated with waterscapes and other topographical features besides including hills, rocks, trees, caves, sand dunes and ridges. They are the “traces of its journeys”⁶⁰. Bates records the lime as the excreta and the salt pans as its urine⁶¹.

These Waakal theories as stories are real to Nyungar. If one were to look at Derbal Yira-gan (as the Perth waters of the Swan River) from the top of Geenunginy Bo Karta, or the hill of Mt Eliza (Kings Park) one could visualise this huge Waakal twisting and turning as it made a way to the coast or Walyalup, of Fremantle.⁶²

The Rainbow Serpent is the major connecting figure, and its tracks are said to delineate subsurface water in many parts of Australia⁶³. The point of this section is to say that once the nature-culture dualism is put to the side, there is great opportunity to engage with living water: with *boodjar* as animate⁶⁴. In this way, people’s health, *waug*, and the health of *boodjar* are directly connected: a spirit of place.

Visualising the Gngangara Knowledge Bidi

Using what we know from historical accounts of wetlands and bidi, we create a fictional narrative prose based on the seasons⁶⁵ to illustrate a lifeway of nature-culture.

Birak, weather heating: morning easterlies, cooling southwest sea breezes
afternoons.

Walking westwards, Joondalup *Mulur kurliny*, going to the lakes.

Signified by *mootja* blossoms

Time for *manju*, trading *wilgi*, ochre, gathering families.

Catching fish, family fires around waterways and in waterways and inlets,

Dancing *midar*, night after night, Banksia flowers, soaking *mung-gaitch* in clean
water depressions,

Drinking in delight.

Fledglings off nests, reptiles shedding old skin for new.

Frogs out, hiding now, *kooyar gwab jeerung* nice and fat.

Wangkiny katitjiny every sunset, dancing and acting the day in reflection. Songs
for the ancestors, acknowledging *waugal*. *Ngany waug murditj*.

Bunuru, hot time, little rain. Hot easterly winds, stay near coast for cool breeze
afternoon. Lots of fishing now, rivers, estuaries, wetlands.

Marri flowers, go to coast, salmon running.

Djir-ly *Zamia* flowers, cones coming, turning red, burying in sandy waterways
to make edible.

Bidier maam firing *karlap*, young men droving *yongkar*; opening country

Bidier firing *pinjar*, getting ready to get the *yanget*

Watch the cones for *waitj* – and catch him. And follow the rules:

“... *them djilkis when we was kids they never let us touch ‘em till after christmas*”

Wangkiny katitjiny every sunset, dancing and acting the day in reflection. Songs
for the ancestors, acknowledging *waugal*. *Ngany waug murditj*.

Djeran, hot by day, shorter, cooler nights. Light southerly breezes. Flying ants at sunset.

Time for red flowers, red flowering gum and summer flame flower; sheoak flowers coming.

More banksias flowering, nectar for little birds.

Picking up *Zamia* cones, ready to eat.

Getting root bulbs of *yanget* and *djubak*, fresh water fish, frogs and tortoises, *yargan*.

Nice fat *karda*, race horse goanna.

Rain is starting, fix up *maya* shelter, make *bwoka* from kangaroo skin, stitch on buttons, ready for winter and cold.

Wangkiny katitjiny every sunset, dancing and acting the day in reflection. Songs for the ancestors, acknowledging *waugal*. *Ngany waug murditj*.

Makaru brings cold and wet. Move back inland, follow *bidi*, just small family groups.

Rain across the landscape, wetlands, rivers and waterholes fill,

Hunting *yongka*, nice warm cooking fires, everything in season.

Pairs of ravens flying together, flying quietly. *Mali*, Black Swan, getting ready for nesting.

Purple flowers, start to make way for the white and cream flowers of *djilba*.

Wangkiny katitjiny every sunset, dancing and acting the day in reflection. Songs for the ancestors acknowledging *waugal*. *Ngany waug murditj*.

Djilba, flower time, yellow Acacias and soon purple climbers across the bush lands.

Kwongan and *yal* - sands wildly alive. Cold nights still, warming days, crisp and clear. Walking eastwards...

Waugal's image across the cloudy sky, heralding rain, thunder, and then sun.

Acknowledge *waugal*, sing out welcome.

Rivers swollen, waters brown, waters clear, wetlands brimming, *ngamar* still full, feasting food aplenty.

Birds on nests; ducks and swans. Leave them for later.

Weather warming, grass tree *balga* flowers showing, season changing.

Wangkiny katitjiny every sunset, dancing and acting the day in reflection. Songs for the ancestors, acknowledging *waugal*. *Ngany waug murditj*.

Kambarang, still more flowers, bushland drying. Banksia candles, *mootja* showing, *djubatj* blooming.

Occasional showers, days are warming, waters retreating: soaking, flowing, babbling.

Aliwah! watch for snakes, lying in sunshine: hungry, waiting. Nestlings screaming, for mother to bring food.

Hunting *waitj*, getting *koomal* tasty possums,

Take a handful of sand, rub under *ngai*, sing out to *waugal*: fishing traps ready, tortoises in abundance.

Wangkiny katitjiny every sunset, dancing and acting the day in reflection. Songs for the ancestors, acknowledging *waugal*. *Ngany waug murditj*.

In this prose we described the long now, the sense of the past, present and future being together in the 'yeyi', now. It is an example of a practical use of the third way – concepts illustrated are accurate from a Western science perspective and align with Noongar knowledges of place. It illustrates a spirit of place, within a nature-culture – where there are overlapping interdependences devoid of dualisms of separation.

Changed hydrology and impact

Noongar people believe that if you harm the resting place of the rainbow serpent or his earthly beings at the place of water then the country would dry up and die.⁶⁶

For the majority of the colonial history of the Swan Coastal Plain in general, and the Gngangara groundwater system specifically, the relationship between humans and wetlands can be thought of as a one way negative environmental influence. Many European settlers found the local wetlands alien, barren, lifeless and dangerous to human health (in comparison to those wetlands left behind in Europe). One newspaper article of the time described Lake Monger as flat, half burnt, dried up and devoid of even birdlife⁶⁷. This negative view of the swamps persisted so that in 1869 the Inspector of Nuisances reported that Perth had “witnessed a great deal of sickness with many cases of local fever occurring, some of them fatal”⁶⁸ and in 1873 the Reverend Meadowcroft warned that if effectual drainage was not adopted quickly then “the city would probably be visited by some dire epidemic”⁶⁹. The swamps north of Perth town site would become loathed by many settlers, seen only as obstacles in the path of the town’s expansion and the breeding grounds of mosquitoes and other vermin⁷⁰. As mentioned above the vocabulary of some types of wetlands – such as swamps and marshes – has inferred disease and vermin-ridden, the source of ill-health, to be treated as good-for-nothing wastelands. Indeed many of the wetlands on the Swan Coastal Plain were used as sumps for stormwater runoff, or landfill sites for domestic and industrial waste, and because of connections to the water table have maintained a groundwater pollution plume. This reinforces some on-going public perceptions of wetlands as a place of exposure and ill-health. Mosquitoes, swarms of non-biting midges, sediment odours, the threat of fire and smoke, and sources of contaminated water, promulgate active avoidance where management responses are demanded by some locals.

An overall history of colonial wetlands (loss) on the Gngangara groundwater system⁷¹ reveals a shift in attitudes and behaviours with respect to wetlands, superimposed on their diminishing areal extent.

Scientists and historians have documented this wetland decline. Most wetlands of the Swan Coastal Plain have disappeared because of urban development or have undergone one or both of two characteristic changes: urban infill (obliteration of wetlands), and over-extraction of groundwater resulting in the encroachment by terrestrial vegetation where water levels have declined⁷². These characteristic ways have physically diminished the representation of surface water wetlands on the Swan Coastal Plain. Groundwater over-extraction from bores lowers the water table by creating negative pressure upwards, drawing the water down. Rainfall declines have further lowered water levels. Wetlands are surface expressions of groundwater levels, so lowering the water table exposes the sediments to drying more than they would normally.

Exposed sediments dry out and heat up. Clayey and organic sediments crack, and when exposed to fire organic rich sediments burn. For all of these scenarios, where acid sulphates are present they oxidize and then when rewetted they generate sulphuric acid. This acidity mobilizes heavy metals which can be toxic. The exposure of acid sulphate soils from previously anaerobic sediments (acidification), an over-supply of nutrients from decades of flow from urban areas or horticulture (resulting in eutrophication), and discharge of industrial, urban and agricultural chemicals to pollute waterways (with toxic effects on biota), have contributed further to wetland decline.

For the remaining wetlands things have changed in the last few decades. Remnants of a once more widespread, connected coastal wetland system are enthusiastically protected as recreational or natural assets. Included amongst them are nature reserves, wetlands of national importance, and wetlands in national parks, regional parks, recreational reserves, or state forest. While representatives of most wetland types remain on the Gngangara groundwater system, most scientific information on these wetlands comes from monitoring work (or limited survey work) conducted in the larger, more iconic and usually more permanent wetlands.

Some feature wetlands, particularly ones with permanent water and active and often intensive management regimes, are seen as urban assets where property pricing increases with decreasing distance from an urban wetland⁷³.

Noongar stories, science, health and wetland protection

“...it’s enough for you to know that these creatures do exist, and they are still in these waterways...”⁷⁴

Noongar have protocols to follow when they are around the Waugal’s sacred waterholes⁷⁵. Dorothy Winmar put it this way:

They believe in the Waakal very dearly. They reckon without the Waakal around they would have no water. They would not let the kids go and torment the Waakal. They (Nyungar) would drive them away. There is a Waakal in the Swan River and he very rarely shows himself. If the water was muddy, the old grannies used to say don’t swim in there, because he is having a feed. Don’t swim (warra wirrin or bad spirit); wait until the water is clear then you can go and jump in (quop wirrin or good spirit). He was very important to their lives, because they believed in having fresh water. They wanted the water, so they wanted the snake to stay alive⁷⁶

From the stories of elders Dorothy Winmar, Tom Bennell, and Janet Hayden, Collard et al. maintain that this belief in the Waakal “is as relevant today as it has been for millennia”⁷⁷.

A ritual continued by Noongar is the practice of calling out to warn the spirit of the water of one’s approach⁷⁸. Today, Noongar still typically call out to a Waugal and throw

sand in the waters before approaching and again when leaving a water source⁷⁹, and this is done increasingly by non-Noongar *wadjela* as a sign of respect.

The contribution to health is also acknowledged:

The *Waugal* was said to be responsible for attracting the rain and keeping water holes and springs replenished. It was seen to be both a destructive and creative force in that it could cause sickness as well as cure illness.⁸⁰

Citing a senior Noongar elder, McDonald et al. describe a groundwater related health support for a site near Lake Mariginiup:

It was used for pit healings; they used it like a sauna. They would dig a pit and put a fire in it and put rocks over the top and then heat them up. And then put branches and myrtle and stuff like that. It would be like a sauna and get the essences out of the flowers.⁸¹

Based on their review of oral histories and ethnohistorical texts, the same authors concluded that "...the spiritual and cultural health of Aboriginal people is considered to be dependent on the health and vitality of living water"⁸².

Noongar communities are well aware of the way contemporary practices in wetlands can violate the health and vitality of living water. Some request any disturbances to sediments to be reconsidered on ethical grounds. Any action that penetrates the sediments should be reconsidered in this way. An example relates to Lake Jualbup (from *yual* - to come here - on or by this location, or *djilba*, the season of rising water), an urban wetland in Shenton Park where local suburban residents lobbied intensively to add a polymer layer to the sediments so the wetland can retain stormwater runoff in dry times, and increase its aesthetic appeal (and the value of their property). Representatives from South West Aboriginal Land and Sea Council (SWALSC) and the Whadjuk Working Party (WWP) were consulted on this proposal and they objected because of the risk of disturbance to the bed of the lake:

...water was seen to be of major importance to Nyungars (and the wider population of Perth) and it is essential that we take steps to keep the rivers, creeks and lakes here pure, including allowing them to return to seasonal water-level fluctuations where that is appropriate.⁸³

Scientists working with wetlands on the Gnangara groundwater system have also highlighted significant problems associated with disturbing wetland sediments, either through large scale mechanical digging associated with earth works for building and construction and mining, or through the excessive drying and cracking of sediments caused by declining water levels and drought, as described above. These disturbances generate an acidic response, with consequences for aquatic life, and they are recognised by guidelines produced by the State Government⁸⁴.

Through either mining (for diatomaceous peats in the 1970s) or through groundwater decline, Lake Gnangara is now permanently acidic, caused by the loss of buffering and the perpetually high levels of sulphates in the sediments⁸⁵. It is interesting to note that the State Heritage Register records Lake Gnangara as a:

"Mythological site; historical hunting place. A dangerous *Waugal* inhabited the lake and the area is, therefore, referred to as a *winnaitch* (avoidance) place. While not used as a camping area, it was used for hunting kangaroos and emus"⁸⁶

A similar issue is raised by fire and wetlands on the Gnangara groundwater system. Early settlers describe how Noongar would fire the swamps in the dry times to

improve the flavour of the rhizomes of *yandjidi* (the rush *Typha*) when it is harvested in early autumn⁸⁷, and this was recorded by Grey in 1841 as a “sort of cultivation”⁸⁸. A practice of firing swamps was not uncommon for the most part of the 20th Century by horticulturalists who used the organic soils for their local production of vegetables and fruit; the firing was done since it provided ash as a fertiliser for the new winter/spring crops. The practice has, however, become increasingly problematic because the organic sediments themselves burn, and these peat fires are extremely difficult to extinguish until the winter rains saturate the soils some months later. These contemporary results suggest that particular Noongar practices for firing swamps are more beneficial in the dry times so that the sediments are not ignited, and/or that the hydrological changes that have occurred in more recent decades have made the organic soils more vulnerable to fire in autumn. Noongar elders are well aware of the drying of the landscape⁸⁹.

Discussion and Conclusion

In this paper we set out on a *katitjiny bidi* to answer the question of how can both Aboriginal and Western sciences produce a more complete explanation of the Gngangara Mound, for a healing intent? At the outset, one of our intentions was to produce a conceptual narrative that illustrates relationships beyond groundwater ‘dependence’; either the city of Perth’s dependence on groundwater for domestic and other use, or the environmental perspective of groundwater dependent ecosystems. We showed that concepts fundamental to the *kundaam*, the Noongar belief system – such as the ‘long now’, *boodjar*, as a nature-culture characterised by interdependences, along with an animated spirit of place, are accepted by Western sciences. This is particularly so through a linguistic critique of Western concepts of separation which have until recently been pervasive in scientific rationalisations for actions taken which have colluded over time to reduce the richness and integrity of the Gngangara groundwater system. Noongar concepts underpinned by systems of obligation and relationship to *boodjar* through kinship illustrate southwestern Australian ecosystems using a monism of spirit and matter. *Boodjar*, the extended concept of place which holds together knowledge, respect and care for water, waterways and wetlands is of immense significance and offers hope for healing. Accordingly one of the outcomes of this analysis has been a relearning of living water, and of a more critical notion of groundwater *interdependence*.

In this paper we have illustrated the power of language and its embedded ways of knowing, which deeply affects the people-place relationship. Narratives of separation embedded in English and European languages have resulted in ongoing disregard and contempt for wetlands and groundwater systems, resulting in continuing over-use and further damage to remaining representative wetlands features. From a Noongar point of view, considerable hope is offered by the new materialists⁹⁰ who illustrate that these separations – such as the people/nature and spirit/matter binaries – are unstable, ignore ongoing interdependence and ultimately result in ongoing ignorance of climate change over decades. This can be seen as madness, a mutation of our self-other relationships.

A cure for this madness⁹¹ is not to see differences as oppositional or dualistic but as monistic continua – a position which enables the Earth to be seen as it truly is, animated by countless living and non-living forces and energies. As can be seen through languages such as Noongar, the Earth is neither inanimate nor inert. Instead, there is an intrinsic interdependency that cannot be denied. Using a perspective underpinned by Noongar language and ways of knowing to view our place, we recognise a deep, interconnected relationship of care. As Nannup says, people are “carers of everything”⁹². It is a dialogical, communicative relationship in which the *kalapgur* – the people of the place – understand, love and defend the proper use of *Boodjar* through astutely caring for it and its *gabbidordok*,

living water or water of life. Acknowledgement and communication with energies and spirits of place – such as singing out publicly – convey and reinforce deep respect and reverence. Such an attitude results in attention, devotion and kindness to one's broad landscape. This is made possible through a third way: a dialogical process of *katitjiny bidi*, for interdisciplinary Noongar and Western knowledge development – where commonalities are celebrated as possibilities of Noongar-led on-ground place-healing.

Noongar interpretations of country do not distinguish between landscapes and waterscapes, because Noongar cosmology and relationships start from seeing them as whole. Likewise it is implausible to dichotomise groundwater and surface water. In fact, in narratives the *Waugal* travels above and below ground creating water sources, more generally part of the interconnectivity of water (sky, land and groundwater)⁹³. Western science now understands that the surface waters and aquifers are interconnected to various degrees, even though the early hydrological models have treated the systems as separate. There is now no question that life on the surface depends on these connections, and on the vast (but depleting and exhaustible) reserves of water. And human behaviour on the surface dictates its condition, whether it be draining, fertilising, building, boring and pumping, or being reverent or irreverent to water, or being wary, or burning appropriately or inappropriately, or harvesting food, or respecting water and its cosmology. These groundwater reciprocities and interdependencies can be enriched by on-going Noongar stories and contemporary social and ecological thought.

Throughout this paper we have shown the strengths and limitations of languages: English for example does not have a word such as *boodjar*, a concept of landscape which includes all interrelated systems of interdependence. European languages, particularly English, are abstracted and devoid of place-based meaning. For these reasons we suggest that for human and ecological health and well-being, education for management of groundwater and wetlands must include Indigenous language studies – including the role English has played in the colonisation and depletion of Country. For the region of southwestern Australia we suggest Noongar language along with its place-based respect is necessary to gain a local sense of *boodjar* – a deep interrelationship with Country.

Restoration of Noongar language and ways of knowing – particularly through narrative – can enliven ecosystem restoration, and facilitate understanding of the relationship between people's health and ecosystem health. A spirit of regeneration can be awakened, revitalising much more than just where water lies in the land or how it stretches from the basin. It can awaken water, life, our relationships and our understandings of the world and each other. We call upon all Australians to sing out to the spirits of their places – to acknowledge their living natures and show the resulting respect and reverence which arises.

Notes

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³ Pierre Horwitz is Professor of Environmental Science at Edith Cowan University, Western Australia. He has over 30 years of research experience in coastal and inland wetland ecosystems in southern Australia, where his policy intentions are related to better integrating the social and environmental determinants of human health.

- ⁴ We capitalise 'Country' in recognition of its animate nature-culture, a concept developed later in this paper.
- ⁵ Stocker, L., Collard, L., & Rooney, A. (2016). Aboriginal world views and colonisation: implications for coastal sustainability. *Local Environment*, 21(7), 844-865. doi:10.1080/13549839.2015.1036414
- ⁶ Ibid.
- ⁷ Kinnane, 2005.
- ⁸ Collard, L., Palmer, D., (2015), *Koorlankga wer weirn: Indigenous Young People and Spirituality*, In: Handbook of Children and Youth Studies, Springer, pp. 875-888.
- ⁹ Berkes, F., Kislalioglu, M., Folke, C., & Gadgil, M. (1998). Mini-reviews: exploring the basic ecological unit: ecosystem-like concepts in traditional societies. *Ecosystems*, 1(5), 409-415.
- ¹⁰ Hallam, S. (1991). Aboriginal women as providers: the 1830s on the Swan. *Aboriginal History* 15: 38-53.
- ¹¹ Appleyard, S. and Cook, T., 2009. Reassessing the management of groundwater use from sandy aquifers: acidification and base cation depletion exacerbated by drought and groundwater withdrawal on the Gngangara Mound, Western Australia. *Hydrogeology journal*, 17(3), pp.579-588.
- ¹² Ibid.
- ¹³ McFarlane, D., Strawbridge, M., Stone, R., & Paton, A. (2012). Managing groundwater levels in the face of uncertainty and change: a case study from Gngangara. *Water Science and Technology: Water Supply*, 12(3), 321-328.
- ¹⁴ Davidson W.A. (1995) Hydrogeology and groundwater resources of the Perth Region. Western Australia Geological Survey, Western Australia, (Bulletin 142).
- ¹⁵ McFarlane et al. 2012.
- ¹⁶ Department of Water and Environmental regulation (2018). Our groundwater future in Perth: Securing Gngangara groundwater and adapting to climate change. Government of Western Australia, Perth.
- ¹⁷ Moore, G. F. (1850). *Descriptive Australian vocabulary*. London: WM. S. Orr & Co. pp.32, 37
- ¹⁸ Ibid p.11
- ¹⁹ Van den Berg, R. (1993). *Changing Years*. *Journal of the South Pacific Assoc for Commonwealth Literature and Language Studies* Number 37.
- ²⁰ Goode and Associates (2008). South West regional water plan: Workshops held with the Nyungar community. Department of Water, Perth, Western Australia. p.23
- ²¹ Macintyre et al 2003:13, cited in Goode and Associates 2008 p. 23.
- ²² Nannup, N. (2003). The carers of everything *Swan region strategy for natural resource management*. Perth, WA: [file:///C:/Users/213509/Downloads/Nannup+-+CarersofEverything%20\(2\).pdf](file:///C:/Users/213509/Downloads/Nannup+-+CarersofEverything%20(2).pdf). p.1.
- ²³ *Waugal, wagyl, wakal, waakal and wogyl* are all used in this document to represent the same highly significant serpent, as spellings have been kept consistent with the historical source. The same principle is applied to other apparent Noongar spelling inconsistencies.
- ²⁴ South West Aboriginal Land and Sea Council. (2012b). Spirituality. Retrieved from <http://www.noongarculture.org.au/spirituality/>
- ²⁵ Ibid.
- ²⁶ O'Connor, R., Quartermaine, G. and Bodney, C. (1989) *Report of an Investigation into Aboriginal Significance of Wetlands and Rivers in the Perth-Bunbury Region*. Leederville: Western Australian Water Resource Council.
- ²⁷ Actant is a term used, particularly by those interested in new materialist social theories, to refer to the multiple forces, energies, relationships and other elements which act together in an agential manner, to bring out some kind of change.
- ²⁸ Seddon, G., 1972. Sense of Place a Response to an Environment, the Swan Coastal Plain, Western Australia. p. 262
- ²⁹ Latour, B. (2017). *Facing Gaia: Eight Lectures on the New Climatic Regime*. GB: Polity. p.14
- ³⁰ Ibid. p.19.
- ³¹ Ibid. p.8.
- ³² Ibid. p.63
- ³³ Ibid. p.65.
- ³⁴ Ibid. p.71.
- ³⁵ Bates, D. (1985). *The native tribes of Western Australia*. Canberra, Australia: National Library of Australia. p.47
- ³⁶ Ibid. p.193
- ³⁷ Moore, 1850, p.45
- ³⁸ Bird Rose, D. (1996). *Nourishing terrains: Australian Aboriginal views of landscape and wilderness*. Canberra: Australian Heritage Commission.
- ³⁹ Bates (1985)
- ⁴⁰ Wooltorton, S., Collard, L. and Horwitz, P., 2015. Stories want to be told: Elaap Karlaboodjar. *PAN: Philosophy Activism Nature*, (11).
- ⁴¹ Stocker et al. (2016).
- ⁴² Latour 2017, p.71.
- ⁴³ Bird Rose, D. (2004). Fresh water rights and biophilia: Indigenous Australian perspectives. *Dialogue*, 23(Three), p.39.
- ⁴⁴ Collard & Palmer (2015).

- ⁴⁵ Hallam 1991.
 - ⁴⁶ Green, N. (2013). Chapter 8. 'Survival against all odds': The Indigenous population of metropolitan Perth, 1829–2001 In C. Hansen & K. Butler (Eds.), *Exploring urban identities and histories*. Canberra: AIATSIS. p.135)
 - ⁴⁷ Cited in Hallam (1991).
 - ⁴⁸ Approximately 50 km north of Gingin in the Moore River region.
 - ⁴⁹ Rooney, B. (2002). The Legacy of the Late Edward Mippy: An Ethnographic Biography. PhD thesis. Centre for Aboriginal Studies, Curtin University. p. 267).
 - ⁵⁰ Edward Mippy, cited in Rooney 2002, p. 268.
 - ⁵¹ Green, 2013, p.135.
 - ⁵² McDonald, E., Coldrick, B., & Villiers, L. (2005). *Study of groundwater-related Aboriginal cultural values on the Gngangara Mound, Western Australia*. Retrieved from https://www.water.wa.gov.au/_data/assets/pdf_file/0019/5473/82492.pdf
 - ⁵³ Hallam, 1991.
 - ⁵⁴ Hallam, S. (1986). Yams, alluvium and villages on the west coastal plain, in Graeme K. Ward ed., *Archaeology at ANZAAS Canberra*. Papers presented at Section 25A of the 54th Congress of the Australian & New Zealand Association for the Advancement of Science, May, 1984. Canberra, pp. 116-132.
 - ⁵⁵ Such as Lullfitz et al.: Lullfitz, A., Dortch, J., Hopper, S. D., Pettersen, C., Reynolds, R., & Guilfoyle, D. (2017). Human Niche Construction: Noongar Evidence in Pre-colonial Southwestern Australia. *Conservation and Society*, 15(2), 201-216. doi:10.4103/cs.cs_16_75
 - ⁵⁶ McDonald, E., Coldrick, B., & Christensen, W. (2008). The Green Frog and Desalination: A Nyungar Metaphor for the (Mis)Management of Water Resources, Swan Coastal Plain, Western Australia. *Oceania*, 78(1), 62-75. p.68.
 - ⁵⁷ Bates (1985).
 - ⁵⁸ Moore, 1850, p.103.
 - ⁵⁹ Ibid.
 - ⁶⁰ Maddock, K. (1978). Introduction. In I. R. Buchler, K. Maddock, & C. P. Mountford (Eds.), *The Rainbow Serpent: a chromatic piece* (pp. 1-21). The Hague: Mouton.
- and
- South West Aboriginal Land and Sea Council. (2012a). Kaartdijin Noongar - Noongar knowledge: sharing our Noongar culture. Retrieved from <http://www.noongarculture.org.au/>
- ⁶¹ Bates (1985), p.221
 - ⁶² Collard, L. (2006). The Cosmology. The creator of the trilogy Waakal of Nyungar Rainbow Serpent. In Leybourne, M. and Gaynor, A. (eds) *Water: histories, cultures, ecologies*. University of Western Australia Press, Perth, Western Australia, p. 122).
 - ⁶³ Bird Rose, D. (2004). Fresh water rights and biophilia: Indigenous Australian perspectives. *Dialogue*, 23(Three), p.39.
 - ⁶⁴ Harding, S. (2006). *Animate Earth: science, intuition and Gaia*. Cambridge, UK: Green Books.
 - ⁶⁵ Please note that for purposes of flow in this fictional narrative, we have not directly referenced each Noongar word. The main two sources used are Moore (1850) and Thieberger, N. (Ed.) (2017) Digital Daisy Bates: . <http://bates.org.au/text/41-265T.html> National library of Australia (NLA). Other sources include: Bennell (1993) for Follow the Rules quote (Bennell, T. (1993). *Kura*. Compiled by Glenys Collard, Nyungar Language Centre, Bunbury). Spellings vary due to inconsistencies in historical sources.
 - ⁶⁶ Noongar Elder, Jack Williams (in Harben and Collard, 2008).
 - ⁶⁷ Webb G. J. (1847) Our Western Australian Home; Being Sketches of Scenery and Society in the Colony, Domestic Manners of the Western Australians. Swan River News, August 4th, p 161.
 - ⁶⁸ Stannage, C. T. (1979). *The people of Perth: a social history of Western Australia's capital city*. Perth: Carroll's for Perth City Council. p.162.
 - ⁶⁹ Ibid. p. 169.
 - ⁷⁰ Markey D. C. (1979) Pioneer Perth. In: *Western Landscapes* (ed J. Gentili) pp. 346-57. University of Western Australia Press for the Education Committee of the 150th Anniversary Celebrations, Nedlands, Australia. p.351
 - ⁷¹ Horwitz, P., Bradshaw, D., Hopper, S., Davies, P., Froend, R. and Bradshaw, F., 2008. Hydrological change escalates risk of ecosystem stress in Australia's threatened biodiversity hotspot. *Journal of the Royal Society of Western Australia*, 91, p.1.
 - ⁷² Davis, J. A., & Froend, R. (1999). Loss and degradation of wetlands in southwestern Australia: underlying causes, consequences and solutions. *Wetlands Ecology and Management*, 7(1-2), 13-23.
 - ⁷³ Tapsuwan, S., Ingram, G., Burton, M., & Brennan, D. (2009). Capitalized amenity value of urban wetlands: a hedonic property price approach to urban wetlands in Perth, Western Australia. *The Australian Journal of Agricultural and Resource Economics*, 53(4), 527-545. doi:10.1111/j.1467-8489.2009.00464.x
 - ⁷⁴ Kickett, E. (1994). The Trails of the Rainbow Serpents. <https://www.youtube.com/watch?v=qxPFx4z3184&feature=youtu.be>

- ⁷⁵ Collard, L., Harben, S. and Van den Berg, R. (2004). Nidja Beeliar Boodjar noonookurt nyinyiny: a Nyungar interpretative history of the use of Boodjar (Country) in the vicinity of Murdoch University. Unpublished Report, Murdoch University.
- ⁷⁶ Ibid, p. 19.
- ⁷⁷ Ibid. p. 19.
- ⁷⁸ McDonald et al. 2005
- ⁷⁹ Edward Mippy, in Rooney 2002
- ⁸⁰ Macintyre et al 2003:13, cited in Goode and Associates 2008 p. 23
- ⁸¹ McDonald et al. 2005, p. 68
- ⁸² McDonald et al. 2005, p.38
- ⁸³ O'Connor et al. 1989
- ⁸⁴ For example, see Western Australian Planning Commission (2008). Acid Sulphate Soils. Planning Guidelines. Western Australian Planning Commission, Perth.
- ⁸⁵ Sommer, B. and Horwitz, P. (2009) Groundwater draw-down and acidification: cycles of decline and recovery in wetlands on the Swan Coastal Plain, Western Australia. *Hydrobiologia* 624: 191-199.
- ⁸⁶ McDonald et al. 2005 p. 45
- ⁸⁷ Moore 1850, p.112
- ⁸⁸ Hallam, S. (2014). *Fire and Hearth*. Nedlands, Australia: University of Western Australia Press.
- ⁸⁹ McDonald et al. 2005.
- ⁹⁰ Such as Latour (2017).
- ⁹¹ According to Latour (2017).
- ⁹² Nannup 2003.
- ⁹³ McDonald et al. 2005.