Quilts that Celebrate the Culture of Australia’s First People, 2

Night Sky Granite Outcrops Water Management

by Pat Forster, 2019 revised 2020
The project of researching information on which to base the quilts, and making the three quilts (Night Sky, Granite Outcrops, Water Management), confirmed my admiration of the ingenuity of Aboriginal people living in the often harsh conditions of Western Australia.

The content in this booklet comprises quotes gathered from a variety of sources, all in the public domain, and most from documents downloaded from the internet. The quotes relate to widely dispersed places in Western Australia, from Noongar language groups in the south-west, through to groups in the Pilbara, central deserts and the Kimberley. The content represents values of an outsider, in regards to selection of what has been included. That is, I am not of Aboriginal heritage. The compilation was a leisure pursuit, and not one of a professional ethnographer.

The booklet is in three parts (Night Sky, Granite Outcrops, Water Management), which in most part are independent, but there are some every few references duplicated because they are pertinent to more than one of the subjects.

I respectfully warn Indigenous peoples that this booklet contains names of people who are deceased.

Pat Forster, 2020
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Statement: The quilt celebrates Aboriginal night sky understandings that emanate from Western Australia.

To recognise the extraordinary knowledge of the night sky by Aboriginal people, the International Astronomical Union has officially given traditional Aboriginal names to four stars—Ginan (for the fifth brightest star in the Southern Cross), Wurrun (for Zeta Phoenicis Aa) and Larawag (for Epsilon Scorpii), which were passed on by Wardaman elder Bill Yidumduma Harney, and Unurgunite (for $\alpha$ Canis Majoris), which comes from the Boorong people.

Materials and techniques:
Patterned fabric is ‘Seven Sisters in the Milky Way’ designed by Marlene Doolan of Aboriginal heritage. The galaxy block is original. The emu is copied from a public domain photo owned by Barnaby Norris and Ray Norris.


Text on the quilt, starting at the top left block and rotating anticlockwise
- emu in Milky Way black spaces signals seasons signifies Marala the emu man
- star maps guided navigation
- moon a distance time indicator
- Seven Sisters Pleiades
- Jundas campsites Hyades
- morning star
- (no text) comet sequin
Review of Aboriginal Night-sky Conceptions, a Western Australian Focus

Patricia Forster
17 The Promenade, Mount Pleasant, Western Australia 6153, Australia
Email: pat.forster@iinet.net.au

Submitted without images on 10/03/2020 to the Journal of Astronomical History and Heritage.

Abstract: This review of night-sky conceptions brings together accounts from widely dispersed places in Western Australia, from Noongar language groups in the south-west, through to groups in the Eastern Goldfields, the Pilbara, the Kimberley and the Central Deserts. Some references have appeared in theses and published papers. Others have been drawn from artist statements of paintings by Western Australian Aboriginal peoples and from other non-conventional sources. The intention for the review is that the scope is traditional, pre-European settlement understandings, but post-settlement records of oral accounts, and later articulation by Aboriginal peoples, are necessarily relied upon. In large part, the Western Australian accounts reflect understandings reported for other states, for example star maps were used for teaching routes on the ground, but there doesn’t seem to be conclusive documentation of star maps being used in real-time navigation. The narratives or Dreamings that have been uncovered differ most from those of other states: narratives which explain creation of night-sky objects and landforms on Earth, events such as lightning; and other narratives which are about socially acceptable or unacceptable behaviour.

Keywords: night-sky conceptions, cultural astronomy, Aboriginal Australians, Western Australia, review

Warning: Readers are respectfully advised that this review contains names of people who are deceased.

1 INTRODUCTION

1.1 The review and motivation for it

This review is the result of an extensive internet-based search for accounts about traditional night-sky conceptions held by Aboriginal peoples whose ‘country’ is completely, or partly, in Western Australia (WA). The search for night sky information was initially to support two art projects, then gained momentum when a key document in the field, ‘Dawes Review 5: Australian Aboriginal Astronomy and Navigation’ (Norris, 2016), which is national in scope, offered many references for the eastern states and the Northern Territory, but few for Western Australia. In correspondence, Ray Norris agreed with my view; and observed that the area, night sky conceptions from WA, is ripe for research (email, 10 August 2018). A year later, I sent Ray a compilation, and he encouraged publication (email, 5 August 2019).

1.2 Limitations of the review

This review represents values of an outsider, that is a non-Aboriginal person, in regards to selection of what has been included. A second aspect is that my internet-based search was largely restricted to freely-accessible accounts, and did not include publications that required special access. I mention also that I have no formal qualifications in the field of Aboriginal astronomy, but do have research skills developed through my doctoral inquiry and sole investigator Australian Research Council Post Doctoral Fellowship.

Further, whether or not current accounts by Aboriginal people reveal knowledge which is free of European influence is a moot point; and narratives evolve over time, in the oral tradition and by different speakers, and sometimes take in contemporary conditions (Maranda, 1972). In particular, narratives reclaimed by Noongar Elders, after the cultural impact of several generations of stolen children, may differ from those told pre-European settlement.

Another contingency is that recorders and researchers may overlay their own world views when collecting and interpreting data. Peer-reviewed papers from academic journals versus non peer-reviewed works, and accepted theses, all of which are identifiable in the reference list, can be an indication of integrity. Some works have been referenced which are non-traditional for academic papers, for example, artist statements for paintings, and storybooks. They were selected on the basis that the authors are Aboriginal, are included to complement other sources of information, and are clearly identified for the critical reader. Justification for storybook references is they are part of the fabric of Aboriginal peoples’ perceptions; albeit that more layers of meaning are revealed to children as they grow in maturity and knowledge (Nannup in Robertson et al., 2016).
1.3 Review organisation and references

The order in which subjects are treated follows the order of Dawes Review 5 (Norris, 2016). The order was chosen so that interested readers could easily read this paper in conjunction the Dawe’s Review. The major headings are Aboriginal number systems; Sun, Moon and eclipses; Stars and constellations; Planets; Comets, meteors, meteorites, craters; Magellanic Clouds; Stone arrangements; Aboriginal timkeeping and calendars; Direction, Songlines and navigation; and Rock art. The numbering of the sections and subsections differs from those of the Dawes Review because of the different scope of findings. Generally, each section starts with a brief summary of the content of references which Norris cites but the authors are not listed – this approach was taken to avoid unwieldy referencing and was based on the assumption that this review would be read in conjunction with the Dawes review.

More references were sourced for Noongar Country in the south-west than for other regions of WA, and they are generally presented first in each section of the review. The spelling of Noongar in the review varies – each version matches that in the papers from which the references were retrieved. Noongar Country is approximately triangular with boundaries from Geraldton down the west coast of WA, and east along the south coast to Esperance: Esperance to Geraldton is the third side of the triangle. Noongar Country has fourteen language groups. Other major groupings referred to, each with multiple language groups, are peoples of the Eastern Goldfields, the mid-west (Murchison and Gasgoyne regions), north-west (the Pilbara), north (the Kimberley), and the Central Deserts. To locate the territories of all language groups in WA, the reader can view, online, the map by Tindale (1940) and a simpler version by the Australian Institute of Aboriginal and Torres Straight Islander Studies (1996). The reader is also directed to online resources when inclusion of pertinent quotes in this review might infringe copyright.

To judge what might be completely-Aboriginal versus European-influenced conceptions of the night sky, the reader needs to know that the first European settlement in WA was in Albany, King Georges Sound, on the south coast in 1826, followed by proclamation, in 1829, of the Swan River Colony which included Perth. Noongar vocabularies, mainly drawn from First People in and around Perth, and quoted here, were published early on by Lyon (1833), Grey (1840) and Moore (1842). Publication of diaries and journals written during early settlement was often delayed, for example, Moore (1884) and posthumously for Salvado (1977) who landed in Fremantle in 1846 and lived most years until 1900 in New Norcia, 130 km north of Perth. Ethel Hassell (1857-1933) settled on the south-east coast of Noongar country in 1878 and wrote sketches of her experiences with Wheelman Noongar people. Her journal, Hassell (n.d.),1 is drawn on in this review, rather than edited versions of it.

2 ABORIGINAL NUMBER SYSTEMS

Norris (2016) cites Blake’s (1981) claim that no Aboriginal language has a word for a number higher than four, and supplies cardinal numbers as counter evidence. Base five counting is common. Numbers in Moore’s (1842) Noongar. The reader is also directed to online resources when inclusion of pertinent quotes in this review might infringe copyright.

A number poster available through the Noongar Boodjar Language Cultural Organisation website, and in current use in Western Australian schools, offers complementary evidence for Moore’s (1842) record. Differences between the poster entries and the oral language recorded by Moore are mostly phonetic or involve simplification of compound words.

Traditionally, Noongar people might have had notional understanding of a quarter and three-quarters, because Moore (1842) lists words for phases of the moon: moon waxing - new moon, first quarter, half moon, second quarter, full moon; and moon waning - three quarters, half moon, and last quarter. In listing the words, Moore (1842: 73) included the proviso that “the meaning of several terms has not been distinctly ascertained.” Certainly, the word for half moon (moon waxing) “Bangal” (Moore: 53) is linked linguistically to the word Banga, half of anything.
Moore’s (1842) vocabulary also has words for ordinal numbers and ordered things, for example:
“First Gorijat; Gwadjat; Gwytchangat.” (Moore: 133).
“Kardijit ... the second son, also the middle finger.” (Moore: 56).
“Kardang Younger brother; third son; also third finger.” (Moore: 56).
As well, the vocabulary has words for two or more objects including: ngalla for brother and sister or two friends. The name for the Seven Sisters varies between language groups but a (contemporary) Noongar name is Danakat (Walley, 2013).

Consistent with most other findings for Aboriginal number systems Australia-wide (Norris, 2016), there are no words in the Noongar vocabularies of Lyon (1833), Grey (1840) or Moore (1842) for higher numbers such as one hundred. However, there is a word for many or abundant: “Bula Abundant; many; much; plentiful.” (Moore: 15). Also, Moore (1884: 225) recorded the following: “To-day I find that a great sensation has been created in the colony by rumours which have come to us, only through the natives, of a vessel that was wrecked nearly six months ago (30 days journey, as they described it) to the North of this—which is conjectured to be about Sharks Bay.” It would be interesting to know how 30 was spoken or gestured.

3 SUN, MOON AND ECLIPSES

3.1 The Sun

Commonly, Aboriginal people across Australia view the Sun as a female spirit, carrying lighted wood (a torch) from east to west across the sky (Norris, 2016). Other narratives cast the woman as chasing or being chased by the Moon man or that the Sun was created by the throwing of an emu egg which broke and caused a fire (ibid).

Macintyre and Dobson’s (2017a) linguistic analysis of Noongar words fits the notion of lighted wood carried across the sky. They link Moore’s (1842) Whadjuk Noongar word biryt for daylight with the word birytch for cone of a banksia, which women carried smouldering to act as a firelighter. Other Noongar words in Moore’s vocabulary that support the Sun-fire link are: Malyar, the ignited portion of a piece of burning wood; and Malyarak, mid-day. Also, about the trajectory, the Kukatja people, south-east Kimberley, hold that: “The sun (tjirntu) is considered to be close to the earth at dawn and further away at sunset.” (Clarke, 2015: 30, quoting Piele, 1997).

In four Western Australian narratives, the Sun is cast as the giver of life. In 1830, Mokare, a Minang Noongar leader (south coast) shared a creation narrative with Captain Collet Barker:

... he told me that a very long time ago the only person living was an old woman named Annegar ... who had a beard as large as the garden. She was delivered of a daughter & then died. The daughter called Moerang grew up in the course of time to be a woman, when she had several children ... who were the fathers & mothers of all the black people. (Macintyre and Dobson 2017a: webpage, quoting Barker, 1830).

Macintyre and Dobson conjecture that Annegar may be Arnga, a bearded Sun-woman, providing as evidence, Arn-ga, the beard a corruption of nan-ga (Grey, 1840), and Sun, Nganga (Moore, 1842).

Whadjuk/Balardong Noongar Professor Len Collard (1959 - ), University of Western Australia, recorded the narrative The Walitj the Eagle, Kulbardi the Magpie, Wardong the Crow and Djidi the Willy Wagtail, told to him, in the oral tradition, by his Aunty Janet Hayden:
When darkness came over the earth, they [the birds] had no way of bringing light back, and the sun wouldn’t come back. They had to send a bird and all the birds volunteered. ... They had to fly as high as they possibly could ... They found old Gnarnk ... They brought the sun back. They told her that without her the earth would die. She was the Giver, they called her the sun, the Giver of Life. (Collard, 2009: 14-15).

Josie Boyle (c1943 - ), Wongai Elder, Eastern Goldfields, relates narratives handed down by her mother. Creation, in brief, was when: the creator (Jindoo the sun) sent two spirit men down from the Milky Way to shape the Earth. They made landforms and the oceans. Then Jindoo sent seven sisters, stars of the Milky Way, to beautify the Earth with flowers, trees, birds, animals and creepy things (Boyle, 2007).

Jakayu Biljabu (1937 - ) of the Martu people, East Pilbara, was born near Pitu, east of Well 25 on the Canning Stock Route and lived with her family longer than most before leaving the traditional life (Martumili Artists, n.d.). The statement for her painting Nyilangkur Claypan n.d., a claypan which is close to Well 25, includes a Dreamtime narrative for the area. It involves the sun as life-giving. The narrative is not reproduced here for copyright reasons but can be read online on the Estrangin Gallery (n.d.) webpage for the painting.

3.2 The Moon

Norris (2016) cites many Aboriginal Dreaming narratives in which the Moon is identified with a man. The Moon/ man link is evident in several Western Australian accounts. Hassell (n.d.: 281) wrote of the Wheelman Noongar people (south-east coast WA): “The moon they say is different for he dies and comes to life, also he gets very fat and thin just before he dies.” Hassell also recorded a kangaroo and moon story. The friends of a boastful kangaroo started avoiding him, so he made friends with the moon. The moon also tired of his boasting and eventually bragged:

“I never die, I live for ever”. There upon the kangaroo said “That is foolish talk” he knew better than that, everything died. The moon declared it was quite true that he [the moon] never died, the kangaroo said things would change now, the moon should die for a short time then come to life again and it has been so ever since. (Hassell: 588-589).

Palmer (2016: 197) refers to Moobbil’s story in his anthropological report for a Native Title claim saying a story “from the Jerramungup area, and relating to a particular site, tells of an interchange between the Kangaroo and Moon, both now being represented in the features of a large granite dome.” Noongar Professor Kim Scott (1957- ), Curtin University, also writes of the Kangaroo and Moon (Scott, n.d.: 15). The setting is potentially the same large granite dome:

I told Clancy of how Kayang [auntie] Hazel made us stop the car at the edge of the bitumen road ... she crossed the wire fence and led us across the shifting soil to a rocky outcrop. She pointed, there: a series of neat circles in the rock that grew small, then larger again. ‘Yongar and Miak, she said, and told the old story of Kangaroo and Moon [very similar to the above] ... It is both a responsibility and a privilege to stand beside where that story is imprinted in stone, and hear its ancient utterance.

For Wongry [Wongai people, Eastern Goldfields?], “Kalu, a man terrified of the blackness of the night, became pale and round, so obsessed was he by his problem. He became the moon and rests on a boomerang on occasions.” (Johnson, 2014: 196, citing Brennan in Noonuccal, 1990). For Lunga people, East Kimberley, “Moon is a man who broke incest (kinship) laws causing death.” (Johnson 2014: 195, citing Kaberry, 1939). Renowned artists Rusty Peters (1935 - ) and Mabel Juli (1931- ), Gija people, East Kimberley, have painted the same topic with small variations. For example:
Theliny Theliny-Warriny, Two Mothers for the Moon, 2012, by Peters (Desert River Sea, n.d.); and Garnkeny Ngarranggarni, 2010, by Juli (Desert River Sea, n.d.). Jaru Elder Jack Jugarie (1927 -1999), East Kimberley, tells the narrative of the moon wanting to marry his cousin sister, who was inappropriate for him (Goldsmith, 2014). An old woman tried to redirect his interest but the marriage took place. No consequences were mentioned - Goldsmith suggests the narrative may not be complete.

Other moon narratives address different subjects. One relates to the cave Meekadarabee (the bathing place of the moon), south-west Noongar Country. A girl drowned herself in the cave after her lover was killed. When the moon is bright, you can see her hair reflected in the water. A fuller version of the narrative can be read online at South West Aboriginal Land and Sea Council (n.d.).

A creation narrative for Lake Coogee in Perth, related by an Aboriginal consultant during a land survey (McDonald et al., 1997), tells of a sparrow and a hawk that flew to a round hole in the earth where the moon rested during the day. The hole is near North Lake. The two birds stole fire from the moon in the form of a firestick. They flew along the limestone ridge near the ocean. The bush caught fire. The moon called his uncle, the ocean, to help. The ocean rose and extinguished the fire. Nyungars were drowned, and the lakes in the area were formed, including Lake Coogee.

Perth Aboriginal people called Dale's Cave, located north-east of Perth on the bank of the Avon River, “‘Mountain of the Moon’, because they believe that the moon once entered that cavern, and left the print of her hand on its side.” (Armstrong, 1836: 789). Another version is that:

Legend has it that in the Dreamtime the moon was a man on the earth and some warriors chased him into this cave. He got tired of being confined there so he put his hand on the cave wall and using that leverage he burst out, making the jagged hole in the roof and escaped into the sky where he roams around still. (Shire of York, n.d.: 4).

Nora Nungabar (c1919 - 2016) of the Martu people, East Pilbara, was born and grew up in country that became Wells 33 – 38 of the Canning Stock Route (Martumili Artists, n.d.). Her painting, Kinyu n.d., depicts Kinyu (Well 35, Canning Stock Route). The statement for the painting (Estrangin Gallery, n.d.) describes the Dingo Dreaming for the area in which dingoes with puppies are looked after by the moon, and they travel east towards the rising moon, to Kinyu. A fuller version of narrative can be read on the Estrangin Gallery webpage for the painting. For the Mowanjum community in the Kimberley, dark patches on the moon were from when a whirlwind carried away a disobedient girl and put her into the moon (Johnson, 2014, citing Utemorrah et al., 1980).

As well as being a subject of Dreaming narratives, the Moon is recognised as a weather indicator by Aboriginal people. Norris (2016: 9) explains that, “In cold weather, a halo often surrounds the Moon, as a result of ice crystals in the upper atmosphere.” A halo was also linked with cold weather by Ngadju people, Eastern Goldfields, WA. To them (O’Connor and Prober, 2010: 22): “A big circle around the moon indicates rain and cold temperatures.” and “The new crescent moon is a good time for hunting — when it is shaped like a boomerang. The kangaroos travel then, and animals come out and move around freely because it is dark. There is also an abundance of fish down at the coast before the new moon.”

Rusty Peters, East Kimberley, provides another insight into weather prediction in the statement for his painting Dry Season, 2013: “It’s getting dry, big dry season. You know it’s going to be hot when the stars are all [gestures twinkling movement] and the moon, so bright.” (Desert River Sea, n.d.: web page).
3.3 Solar Eclipse

Traditional beliefs by Aboriginal people about solar eclipses include that they are bad omens, they are caused by a conjunction between the Sun (woman) and the Moon (man), and they are caused by something covering the sun (Norris, 2016). Hassell (n.d.: 146-147) relates a narrative that fits the last category. In summary: Long ago, the Zhi (sun) shone all day, and all night the Maak (Moon) was bright. The men hunted in the daytime, but then they went to sleep and did not hunt, and the women scolded them. There was a big noise, and the Zhi and Maak came down and split the earth in half. The men that slept and the women that scolded were left on one side. Those who had hunted remained on the other side. It is never cold, because the Zhi shines all day and the Maak all night. But now and then the Nunghars on the other side of the sun want to know what is going on here, so they crowd together and they tip the sun over one side as they peer down. There is a lot of them so they cover the Zhi and make it dark, then it is very cold down here. They take the warmth away for themselves. But they don’t stay long, they only stop long enough for each one to look down.

3.4 Relationship between Earth and Sky

In most accounts:

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Earth and sky are two parallel worlds which mirror each other, and the sky ... is a reflection of the terrestrial landscape, with plant and animals living in both places ... Clever men are said to be able to move between land-world and sky-world ... The sky is often regarded as being relatively close to Earth ... Many groups believed that all celestial bodies were formerly living on Earth, partly as animals, partly as men, and that they moved from Earth to sky. (Norris, 2016: 11).
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The same elements of the Skyworld are described by Clarke (2014, 2015), including for language groups in the Western Desert, part of which is in WA. Johnson (2014) provides other examples for north-west WA and the Kimberley.

The epic creation Dreaming ‘Moondang-ak Kaaradjiny: the Carers of Everything’ (Nannup, 2008), told by Noongar Elder Noel Nannup (1948 - ) has the same elements except for clever men. In summary, spirits moved across the land during the nyetting (cold time), realised they were going to become real, and wanted one group (people, plants or animals) to become carers of everything. A spirit serpent, the Wogari, used all its strength to partially lift the sky, became real, created trails and hills, went underground, and rose again where there would be lakes. Then, the sky was lifted up from Earth, by spirit children working in unison; the Milky Way was created by a spirit woman who carried spirit children up in her hair; shooting ‘stars’ are spirit children returning to Earth; spirits on Earth became real with the first hint of wind. Others tell the same Dreaming or elements of it including Noongar Elder Toogarr Morrison (1950- ) (Goldsmith, 2014), and the narrative is on a plaque in Victoria Park, Claisebrook, East Perth (Goldsmith, 2014). Robertson et al. (2016) have linked components of the narrative with events that are believed scientifically to have happened over millenia, focussing on the Permian ice ages, 350 million years ago, through to the Holocene flood, 7000 years ago. The purpose was not to prove the Carers of Everything narrative is true, but to seek synergies of meaning between cultures.

An account by Ethel Hassell (n.d.: 187) touches on an earth/sky relationship. She asked Tupin, an Aboriginal girl who knew a lot of Native law, with Tupin’s friend alongside:

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Is the earth round like this ball (holding up a ball of crochet cotton) or square like the box I am sitting on? “Round like a ball” both the girls promptly replied. “How do you know?” I asked. Both the girls promptly replied “Oh Missus just look all round yer. See the sky touching the earth all round. Wherever you stand and look it is all round put baby down to walk he soon run round, not always straight along fence, see ship get lost they run round, say um Yonga [kangaroo] run straight very little, then run round and Missus white man know it … How is it that extracts of this account are quoted to indicate that a traditional belief of Wheelman people is that the earth is finite and/or round? Maybe because extracts are relied upon.
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The Karadjeri people, south-west Kimberley, viewed that the:

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...sky was a canopy covering all and coming down beyond the horizon to meet and enclose the flat surface on which men and women followed the fixed pattern of their lives ... The vault itself was pictured as being composed of a very hard and durable substance. (Johnson, 2014: 23, citing Piddington, 1932).
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The Karadjeri “… thought this substance to be rock or shell.” (Johnson, 2014: 24). Also for the Karadjari, Bulanj, the rainbow serpent, “… is the rainbow of the day-time sky and the river of the Milky Way in the night sky.” (Clarke, 2014: 313, quoting Worms and Petri, 1998).

Places of the dead are also relevant to the Earth and Sky relationship. “Over much of Australia and in particular, parts of the west and northwest, the spirits of the dead went to and resided in the sky-world with the ancestral
heroes.” (Johnson, 2014: 30, citing Berndt and Berndt, 1974); “... but as frequently, there was a specially designated earthly place of sojourn for the dead, always located well away from that of the living.” (Johnson, 2014: 30). For Wheelman Noongar people (Hassell, n.d.: 281):

The sun is the far off land where the natives go and live after they die, no evil spirit can get there, and it is wonderful fertile country. When I [Hassell] remarked that it must be very hot I was told it is not so, the heat came from the sky which was below the sun and had nothing to do with it. The sun was above everything, the stars, moon and heavens, and independent of them all. It was the abode of the departed.

In a native title submission to the Federal Court (Palmer, 2016: 136), Noongar informant Lynette Knapp (south coast) stated that her father had taught her that the spirit of the dead person went “beyond the sun.”

Also from Noongar Country: “The spirits of the dead had to journey under ‘father sea’, west to the land of the dead.” (Johnson, 2014: citing Bates, 1992). In a similar vein, Phillip Chauncy, the Western Australian Government Assistant Surveyor from 1841-1853, wrote:

Before the arrival of a ship from Europe, the Swan River natives supposed that the spirits of the deceased passed into the cormorants which frequent the Mewstone, a granite rock some miles out in the sea opposite the mouth of the Swan River, called by them Gudu mitch, a compound of Gu-urt, the “heart,” and mit or Mitch, the “medium” or “agent” – signifying that this island is the medium or agent by which the spirit of the departed one enters the body of a cormorant. Large flights of these birds used to pass up the estuary of the Swan every morning on fishing excursions, and return to the Mewstone in the evening, and the natives refrained from killing them lest thereby they should be slaying their ancestors. (Macintyre and Dobson, 2017b: web page, quoting Chauncey, in Brough Smith, 1878).

Again, for Noongar Country: “Their general belief is that the spirits of the dead go westward over the sea to the island of souls, which they connect with the home of their fathers.” (Moore, 1842: 83). “In the Kimberleys, the place of the dead was in the west.” (Johnson, 2014: 31, citing Kaberry 1939); and “The Milky Way was also seen as a place of the dead in some areas of the Kimberleys.” (Johnson, 2014: 31, citing Durack 1969).

4 STARS AND CONSTELLATIONS

Norris (2016) observes that, for Aboriginal cultures there are narratives for individual stars, constellations and dark spaces between stars. As does Norris, constellations and dark spaces only are considered in this review. I found few single star accounts from WA, and stars in those are sometimes assigned Aboriginal names, but not European names.

4.1 Orion

Most Aboriginal cultures “… associate Orion with a hunter, a young man, or a group of young men.” (Norris, 2016: 12). This is true for the many Seven Sisters narratives from WA, see Section 4.2 below. A different view of Orion was provided by Jaru Elder Jack Jugarie, East Kimberley. He “… referred to the stars which make up the belt and “sword” of the constellation Orion ... as “Kalarrcar”, the lizard footprint. ... Jack drew both the imprint of the lizard footprint, and the star pattern, noting the similarity between the two.” (Goldsmith, 2014: 142). No narratives about lizard were reported.

4.2 Pleiades

Norris (2016) identifies that, for nearly all Australian cultures, the Pleiades are female, often sisters or a group of young girls, chased by young men, usually in Orion; and that the number seven is puzzling because less than seven bright stars are visible in the cluster; but, in several accounts one or two of the sisters are absent which is consistent with less than seven visible stars. Narratives from WA mostly fit these descriptions.

Two major art projects which involved Elder women painting and telling their Seven Sisters narratives have been completed: one relates to the Canning Stock Route (La Fontaine & Carty, 2011); the other to the Western Desert, central WA, including part of the Canning Stock Route, and also to country between Alice Springs (NT) and Kalgoorlie (WA), and Anangu/ Pitjantjatjara/ Yankunytjara Country (partly in WA, mainly in South Australia) (Neale (ed.), 2017). In addition, Macfarlane and McConnell (2017) bring together Seven Sisters narratives for the Canning Stock Route. In brief, the Seven Sisters are chased by a man (Orion) known by different names by different language groups, who wants to have sex with them. The Sisters fly from place to place, drink at waterholes, create water sources and other landmarks, and, at various locations, they rest, dance, sing, pierce their noses, get lost or sick, hide, get caught by the man/men, defend themselves, suffer rape, escape, split up and regroup.
A Seven Sisters narrative from Bremer Bay, south-west WA, indicates only six stars in the Pleiades, and that the man chasing them is a star of Orion, not the star constellation (Hassell, n.d.). Noongar Elder Noel Nannup (2008: 98) relates:

“When it comes to the story of the Seven, there are really only six, as the seventh is one of the planets, and the planets go the opposite way. This is why you will always hear the desert people saying the seventh sister is coming home. ... You will see the seventh sister getting closer and closer, but then she will go past ... And when that happens, people will say she has visited her sisters.

Six sisters remain in the sky in the creation narrative told by Wongai Elder Josie Boyle (Boyle, 2007). In brief, the Sisters come from the Milky Way to beautify the Earth, and they need water. The youngest sister is sent for it. Two spirit men find her, and she falls in love with them, something that is forbidden. After finding her, the six Sisters return to the Milky Way, leaving the youngest sister with the men.

For the Pitjantjatjara people, Central Desert, partly in WA, the Sisters kept a pack of dingoes for protection against the man but “... he succeeded in raping one of the sisters who subsequently died...” (Haynes, 2000: 78, citing Mountford, 1976). The man pursued the other six who became birds and flew into the sky. He followed them and is seen in the stars of Orion’s belt.

Like Mountford (1976), see above, Noongar Elder Theresa Walley (1937 - ), in her storybook (Walley, 2013), links the Seven Sisters with birds. The Sisters had the names of birds, and were sent to search for their father. But they ventured too far, lay down to rest and never awoke. Their spirits drifted into the heavens and can be seen in the night sky. They return as beautiful birds during the day.

White witnessed a Seven Sisters ceremony of the narrative for desert areas from west of Warburton (WA) to Central Australia (Johnson, 2014, citing White, 1975). The ceremony was for a girl’s first menstruation. It included dingoes as does an account by Mountford (1976), see above. A woman took the role of a man, so represented Orion, who chased seven women. One was raped and died, a consequence of the man being a relative so that the rape was beyond moral behaviour as well as marriage lore. The six sisters continued with the man in pursuit. The women set their dingoes upon him when he attempted rape again.

Two other very different narratives are told about Seven Sisters. For the Goolarabooloo people of the Dampier Peninsular, West Kimberley: Marala the Emu Man (Emu in the sky) chased Ngadjayi (spirit women from the sea) (Salisbury et al., 2016). The spirit women failed to listen to a command of their leader, Yinara, who then shamed them, and together they moved into the sky and became the Pleiades. Stone pillars at Bungurunan Beach, south of Broome, now represent the Ngadjayi.

Hassell (n.d.: 287-294), south-east coast WA, recorded another narrative, in summary that: a man who goes hunting and meets three Kar Kar (men from another tribe). The man asks them to his camp with his wife, children and Wardah, who is to be the wife of the eldest son. They all travel to the coast. A Kar Kar wants Wardah as his wife so the Kar Kar are told to leave. The Kar Kar attack, the man and sons are speared, a wind blows them into the sky: Orion is the man with a son on each side, and the three stars hanging down are the Kar Kar trying to reach them, which is a warning to all not to take in strangers. The wife, children and Wardah hide, and a cloak is spread over the children. A storm blows up, wind catches a corner of the cloak and blows them all into the sky: the wife and Wardah are the two brightest stars in the Pleiades, the dimmer ones are the children because they are covered with the cloak.
The names of many desert locations visited by the Seven Sist
ers are publicly known, in particular along the Canning
Stock Route (La Fontaine and Carty, 2011; Macfarlane and McConnell, 2017; Neale (ed.), 2017). That Seven Sisters
Songline starts in Roebourne, crosses the Pilbara, goes north east up part of the Stock Route, then south east, and
finishes at Innga in South Australia (Macfarlane and McConnell, 2017).

Noongar Elders identify Cantonment and Clontarf Hills in Fremantle with the Seven Sisters, and say that five other
hills in the area have been flattened, but the spiritual essence of the landscape lives on (City of Fremantle et al., 2016)
– the five other hills were quarried early on for the Fremantle Harbour development. Another Seven Sisters place is in
the mid-west of WA:

... in the back of Geraldton ... where that road goes, ... you go over that hill. You see all these beautiful formations
of hills and things. Well along there, there is a lovely story of how they dropped the crystals through there. (Josie

Josie also speaks of a Seven Sisters site in the Eastern Goldfields: a hill in Coolgardie that was a dancing site and the
end of the Sisters’ journey on Earth (Goldsmith, 2014). Noongar Elder Noel Nannup, referring to the Wongai people,
wrote “their Seven Sisters Dreaming starts at a place called Weibo, north of Kagoorlie in the Goldfields, at a very
special place where the sisters came down from the sky.” (Nannup, 2008: 98).

Paddy Walker, Wongai Elder, Eastern Goldfields, described how the Seven Sisters visited Lake Ballard: they stopped
and played, and a man chased them (Gormley, 2005; Menzies Visitors Centre, n.d.). They hid in seven rock holes on
the shore of the lake; became islands on the lake; the man seized the youngest of the girls; a young man loved one of
the sisters and wished to dance with her; and a tree at the end of Lake Ballard is one of the sisters (Brody in Gormley,
2005). In her storybook (O’Brien, 2009), recognised educator (MBE) May O’Brien (1932 - ), of the Wongai people,
names other Eastern Goldfields places which the Seven Sisters visited: a flat-topped plateau near Leonora; a hill near
the plateau called Yabu Yulangu which means the hill where they cried; and places close to Wiluna, Laverton,
Kalgoorlie and Menzies - Lake Ballard, in Paddy Roe’s account, see above, is accessed via Menzies.
Also in the Eastern Goldfields, Ngalia people hold that the Die Hardy Range including Mount Geraldine, is associated with and represents the man who pursues the Seven Sisters, and that peaks in the Yokradine hills represent the Sisters (Muir, 2012). The name of the Yokradine Hills is based on the Noongar term “Yokrakine, yoka kaany, women’s spirit place” (Muir, 2012, 17, source Tim McCabe). Muir (1970 - ) is leader of the Ngalia people. Tim McCabe is a long-standing Noongar Language Teacher, Ph.D. Curtin University.

Lake Ballard looking North photo by Pat Forster 01/08/19

Lake Ballard, the oldest sister became the conical hill, photo by Pat Forster 01/08/19

Men performing the Balga traditional corroboree in the Kimberley carry totem boards which depict elements of the corroboree story. The dance style is traditional, but the story can be current: the story is passed through the generations via dreams; the current owner is Alan Griffiths (Carriageworks n.d.: web page). The totems, traditionally made with hair and now made with thread, depict the Seven Sisters, the Morning Star and other non-night-sky elements, as do the paintings by Alan Griffiths, for example Bali Bali Balga, 2012 (Desert River Sea, n.d.: web page). I haven’t uncovered the connection between the current story and the Seven Sisters and Morning Star.

4.3 The Milky Way

The Milky Way is widely recognised across Australia but interpretations vary, including that it is a celestial river, a canoe, Rainbow Serpent(s), that nebulae are camp-fires; and dark patches in the Milky Way are also subjects of narratives (Norris, 2016). Aboriginal accounts from WA about the Milky Way are considered in this Section, while dark patches are considered in Section 4.5 below.

The Carers of Everything narrative (Nannup, 2008), partly related in Section 3.4 above, describes the creation of the Milky Way by a spirit woman who carried spirit children up in her hair where they became stars. In a similar account on a plaque in Victoria Park, Claisebrook, East Perth, she is referred to as the Charrnock Woman, with long white hair, and her campsite is the Hyades star cluster - Aldebaran is her fire (Goldsmith, 2014).

The narrative of the Charrnock Woman, variously called Charnock, Junda and Jindalee, has many retellings, including by Noongar Elder Trevor Walley (1957- ) on Utube (Walley, 2015) and by Noongar Elder Toogarr Morrison - in story and in two large paintings in public buildings (Goldsmith, 2014). As well, many places in Noongar Country are identified with the narrative. It features in a Songline from Bunbury to Geraldton to Wave Rock (Robertson et al., 2016,
citing Nannup and Hopper, 2015). A strand of her hair snapped off and created the lakes at Joondalup (Robertson et al., 2016). During full moon, you can see her long white hair reflected in Lake Joondalup from the stars (City of Joondalup, n.d.). She left a footprint at Blackwall Reach alongside the Swan River (Robertson et al., 2016). The sandbar in the Swan River at Point Walter is a strand of her hair (Parks and Wildlife Service WA, n.d., audio files by Noongar Elder Marie Taylor (1948- )). She left earth by leaping off Wave Rock, Hyden (Nannup, 2008); her man who ate spirit children lived in Bates Cave, otherwise known as Mulga’s Cave, near Hyden, and the first place where the spirit children returned to earth as stones was Hippos Yawn, at the base of Wave Rock (Goldsmith, 2014, citing the Claisebrook Plaque).

4.4 Crux: the Southern Cross

Interpretations of the Southern Cross by Aboriginal people vary across Australia (Norris, 2016), including that, for people in the Kimberley, the Cross is an eaglehawk (Norris, citing Kaberry, 1939). From Noongar Elder Noel Nannup: “The Southern Cross and the stars around it are really the head of a kangaroo. You can see the ears and the teeth, you can see the kangaroo’s back coming down and the tail going off.” (Nannup, 2008: 103).

In a storybook (Pettersen, 2007) by Merninga-Gnudju Noongar Carol Pettersen (1940 - ), of the south coast WA, four sisters go to a sacred place. They are chased away by men who attack them with spears but they escape by fleeing to the sky, where they become the Southern Cross. In the version recorded by Hassell (n.d.), four sisters are sent to fetch water. Instead of coming straight back, they play. Men of the tribe find them playing and, as punishment, prod the girls in the calves of their legs with hunting spears. The girls run as fast as they can. A big wind springs up and blows them into the sky – they spread out to avoid the spears the men throw at them, which is why they are not clustered like other stars. They stay up there because they are frightened, which is a lesson to other girls not to play when sent on a task, because they will never get to find a man and be married.

From the north-west of WA, the “Southern Cross is the camp of two mothers and their fires are the Pointers Alpha and Beta Centauri. They came to earth in search of food. The fire sticks they carried got out of control and the ensuing fire was captured by people on earth.” (Johnson, 2014: 167, citing Roberts and Mountford, 1974). In the West Kimberley, the Southern Cross is Jina (eagle’s claw print) and the pointers are Gwuraarra (hitting stick) (Salisbury et al., 2016).
Evening twilight / Southern Cross and pointers, at Mount Magnet natural amphitheatre, photo by Jim Forster 22/09/2019

‘Southern Cross over Boorabbin National Park’ art quilt by Elizabeth Humphreys, 80cm x 80cm, 2020. Photo by Pat Forster.

4.5 Dark Spaces

Emu in the Sky, seen as dark spaces in the Milky Way, is widely recognised by Aboriginal people, with the Coalsack as the head, and the body extending along the body of the Milky Way through Scorpius and Sagittarius constellations, although there are other variations (Norris, 2016). Early references to Emu from WA sources cited by Fuller et al. (2014) are of: a resting Emu, by Aboriginal groups in the Musgrave Ranges (Basedow, 1925); and an Emu called Kalaia, by Pitjantjatjara people (Tindale, 1935). Badimia people in the Murchison (Day and Morrisey, 1995) and Watjarri in the Murchison (Goldsmith, 2014) also recognise Emu and use it as a seasonal indicator - see Section 9.1 of this review.

The Milky Way rises over Island Point in the Peel-Harvey estuary, Western Australia.
Photograph by Luke Busellato, Creative commons license to publish
https://commons.wikimedia.org/wiki/File:Milky_Way_over_Island_Point.jpg

‘A Night Outback’ art quilt by Stella King, 80 cm x 40 cm, 2019,
depicting emu with the Southern Cross as its crown. Photo by Meg Cowey.

Hassell (n.d.: 183) recorded a story about Waitch (Emu) in the sky among the Gindies (Stars), told by Tupin, who learnt Aboriginal law from her mother and old father. When thunder was heard, Tupin said “Waitch far away, there she move again, as the thunder rumbled again.” In brief (183 -187, paraphrased): Waitch was blown into the sky in smoke from a fire. She went to the moon to rest, but the moon got fat and squeezed her out. She went to the sun but the Nunghars there did not want her as she talked too much. She went to the Gindies who were keeping the earth up and they allowed Waitch to camp with them if she would help take the load. But little by little, they put all the load on Waitch’s back. She spreads out her wings to keep the load in place. She groans and moves one part of the load from one wing to the other when the weather is very hot. Sometimes she moves her load with a jirk and the whole earth trembles. If she makes too much fuss the Nunghars in the Sun get angry and make it dark, and send out flashes of light to frighten her and make her quiet. When it rains very hard, that is Waitch crying because her load is so heavy.

For the Goolarabooloo traditional custodians of the Dampier Peninsular, West Kimberley, Emu is Marala, the Emu Man (Salisbury et al., 2016: 2-4, citing Mountford, 1973). Marala is an important Bugarrigarra [creation time] being associated with the Ululong Songline. He “was the ‘lawgiver’, and instilled in the country the codes of conduct for behaviour needed to help ensure its well-being”. As he moved along the Songline:

Marala left behind threetoed tracks. He also left behind the grooved impressions of his tail feathers (his ‘ramu’ or ceremonial engravings) when he sat down to rest ... Today, three-toed dinosaur tracks (typically those assigned to Megalosauropus broomensis) and impressions of cycad-like bennetitaleans (Marala’s tail feather impressions and ramu) are seen as testimony to Marala’s journey as narrated in the Song Cycle ... Marala’s emu-like form persists today as a shadow of dark nebulae running virtually the length of the Milky Way.
Three-toed footprint, Gantheaume Point, Broome, photo by Pat Forster 26/06/2009

There are numerous narratives about Marala that address moral behaviour. Jaru Elder Jack Jugarie, East Kimberley:

... described a creature called “Yilgarn” or “Yulgarn” in the Milky Way, near the Emu sky pattern. ... [He] noted that some people regard a dark patch in the Milky Way as the legs of the emu, whereas others regard it as a separate creature called “Yilgarn” ... [He] described Yilgarn as a “leech” sucking the blood from the Emu, and he was very specific indicating the location of “Yilgarn”. It comprises a small dark patch in the Milky Way, near the constellation Scorpius. (Goldsmith, 2016: 141).

Johnson (2014: 112, citing Worms, 1986) reports:

The creation hero spirit, Galalang of the northern Kimberley groups is represented as living in the dark patch of the Milky Way, between the European constellations Centaurus and Scorpius. Remnants of his feathered headdress are seen in Alpha and Beta Centauri which also act as an allusion to Galalang’s establishment of the two moieties within the tribe.

The dark patches were seen as a bullroarer among the Lunga of the Kimberley (Johnson 2014, citing Kaberry 1939).

Haynes (2000: 84, quoting Tindale, 1936) reports:

The Ngadadjara people of the Warburton Ranges WA saw in a long line of dark patches along the Milky Way between Alpha Centauri and Alpha Cygni a great totem board made by two ancestral heroes, the Wati Kutjara, while they were accompanying the seven sisters.

5 PLANETS

Aboriginal people’s star knowledge included distinguishing between fixed stars and the planets that moved straight across the sky; Mercury, Venus, Mars, Jupiter and Saturn were all visible and recognised (Norris, 2016). Hassell (n.d.: 285) wrote that:

Noongars on the south coast though they recognised they [the planets] are different from other stars they called them the mulgas of the tribes and say they visit the tribes also they have the power to look through the clouds, never mind how thick they are or how dark the night be...[and] I was told the names of several tribes of stars, the names I regret to say I have forgotten.

Mulgars were tribal doctors who had magic powers and travelled between family groups or tribes on the ground. The earth-sky-tribe analogy is carried further in a storybook (Winmar, 2009) by Kerry-Ann Winmar, Noongar heritage, in which she describes the stars as looking like campfires, the campfires of the ancestors.

5.1 Venus - The Morning Star

Venus, the morning star, is important in some Aboriginal cultures and is associated with death; for Yolngu people, Northern Territory, Venus was a creator spirit who led humans to Australia and named and created animals and places; some Yolngu perform a Morning Star Ceremony as part of the funeral process (Norris, 2016).

In the Western Desert which is partly in WA: “... the local people viewed Venus (Iruwanja) and Saturn (Irukulpinja) as brothers, with Jupiter as their dog. Irukulpinja and the dog spend most of their time catching food for Iruwanja.” (Hamacher and Banks, 2018: 11, quoting Mountford 1976). For Kukatja people (Gugadja) of the Kimberley, Venus, the morning star, is cast as the man who chased the Seven Sisters (Johnson, 2014, citing Berndt and Berndt, 1989). For Whadjuk Noongar people, Venus signals a time of day: Teean benne kwejijat Hoolat means Venus, daylight now coming (Thieberger, 2017, citing Joobaitch of Guildford and Perth, recorded by Bates).
Jaru Elder Stan Brumby (1933 - 2012), East Kimberley, referred to the Morning Star when interviewed by Goldsmith (2014: 476) and that he, the star, cannot always be seen:

One big star, not too big, come out from sunrise. He come out, at night, proper star. This star, bin fall down, that's the main star, we been use him for... droving cattle, that's the morning star, that's the main star. Well the drover lost that, we can't see him anymore. He's underground here, ... Yeh, yeh, very bright, morning star, he come and take a break now.


5.2 Venus the Evening Star

Some Aboriginal people recognise that the Morning Star and Evening Star are related, but do not necessarily see them to be the same object (Norris, 2016). Moore (1884: 387) recorded:

When I was last in the bush in search of the natives, the stars were shining brightly at night. What star is that?" I said to Deenat, pointing to Venus. "Oh, that is Julagoling," was the answer, "What is it—a man, or a woman, or what?" I enquired. "Oh, very pretty young woman," was the reply. "Where is her husband?" I said. "She has no husband; she has had some children, but she always kills them; she is very powerful in magic. Ah, there she goes off to the West, now to practice her enchantments upon us.

Goldsmith (2014) interviewed Jaru Elders, East Kimberley, who referred to the Evening Star, in the context of the creation of Wolfe Creek Crater. Elder Stan Brumby described the evening star as two stars, and that the mother one, the biggest one, came to the ground and left behind the baby one; and he drew the two stars. Elder Jack Jugarie described how "Wada [star]. Each one moves because the other one wants to come in there, it gives him room to move ..." (Goldsmith: 139); and that a big star was the first to come up a little bit, and that another bright one came up - the moon Yalgarn, and Yalgarn came very close to the star and was too hot for him so it fell in Wolfe Creek Crater.

Kirsty Burgu (1972 - ), daughter of a Ngarinyin Elder, Kimberley, writes about elements of her painting Marriage Laws 2011: that the evening star and moon always try to come closer to each other (Desert River Sea, n.d.: web page). See the web page for the complete statement.

'Venus Appears over Kandimalal (Wolfe Creek Crater)' art quilt by Roberta Chantler, 2019. Photo by Pat Forster
6 COMETS, METEORS, METEORITES, CRATERS

Norris (2016: 20) observes that “Some Aboriginal languages do not distinguish between meteors and comets”, but it could be that the recorder did not distinguish them; and association with bad omens and death is common among Aboriginal people. Consistent with these observations, Moore (1842) has the same word, Binnar, for comet and meteor in his Noongar vocabulary. He also listed:

Binnar A meteor, described by the natives as a star of fire; seldom visible, but when seen considered by them as an omen of death. A remarkably large and bright meteor was observed a few years ago traversing a large space in the heavens from east to west. Its progress was accompanied by a loud crackling sound, like the combined discharge of musketry. (Moore: 1842: 13).

6.1 Meteors

Several Aboriginal groups associate meteors with death, even as causing death, sometimes as punishment for breaking the law (Norris, 2016). Yolunga people, Northern Territory, tell how a spirit, as a meteor, brought fire to Earth, causing massive fires unintentionally; and meteors are also associated with new life, sometimes due to reincarnation of spirits of the dead returning to Earth (ibid).

Noongar Elder Noel Nannup, in the Carers of Everything narrative, references shooting stars, meteorites and meteor showers, in relation to spirit children returning to earth:

I know that we have all been outside on the dark night and seen a shooting star streak across the sky, I have heard some people say make a wish, when we see this we always say by-ee coolunger nyina, which means little spirit children returning to earth. When they reach earth they are nothing more than a little stone, some are a bit bigger than others, and some don’t make it at all. The spirit children return to earth all the time, with a known pattern of large showers about every thirty three years, that is when we believe that our spiritual energy is at its strongest. (in Goldsmith, 2014: 195).

Recognition of meteor showers has not been conclusively reported for other Aboriginal groups (Norris, 2016). The thirty-three year reference to them may be contemporary knowledge.

6.2 Meteorites and Tektites

Bevan and Bindon (1996) review recognition of meteorites, and transportation and utilisation of them by Aboriginal people. Large masses have been found away from, and traced back to, the Western Australian impact sites, Mount Dowling and the Dalgaranga Crater. They were potentially transported by Aboriginal people, but Bevan and Bindon found no reports of that. There are documented examples of Aboriginal people discovering meteorites in modern times - pieces from the Mundrabilla meteorite shower fell and are found on the Nullabor Plain, WA.

No known examples of traditional use of meteorites for practical purposes have been found (Bevan and Bindon, 1996). Explanations are that most samples are friable, although some crystalline meteorites are suitable for tool making. Bevan and Bindon note the use of tektites as sacred objects. “Tektites are small, pebble-like glassy objects of Earth material that have been melted by meteorite impact, splashed up into our atmosphere, and fallen to Earth again under gravity.” (The Australian Museum, n.d.: web page). They are not meteorites, that is, not rocks originating in space.

Clarke (2019) reviews Aboriginal use of a category of tektites called australites, which have been traced back to a meteorite strike in Southeast Asia about 793 000 years ago (Clarke, citing Lei and Wei, 2000) and that rained down on Australia. They are found in a variety of shapes including ovals and teardrops, and are widely scattered, sometimes in ancient Aboriginal campsites. They hold significance for Aboriginal people as magic stones, with their power derived “from their connection to ancestors who went up to the Skyworld after Creation.” (Clarke: 158). Early records for WA indicate that possessors of the stones believed that: they were able to cure sick people and bewitch enemies (Clarke citing Tate, 1879); that faith healing procedures of sucking them from the body could cure sickness (Clarke citing Baker, 1957); and carrying them gave power to medicine men to convey messages long distances (Clarke citing Baker, 1957). The glassy composition of australites sets them apart from meteorites, as does their shape and composition, but there is a history of them not being distinguished in the naming.

Hassell (n.d.) found a booliah (wizard stone), which she gave to an older Aboriginal woman, and which others held to ensure their babies would be boys. She also saw stones owned by a Mulga (tribal doctor) that he used for rain making, curses and other things. Two were iron stones “... I am certain were meteorites. ... [Another was] in size and shape like a goose’s egg but dark green colour and extremely heavy and smooth.” (Hassell: 249). Clarke (2019) refers to Hassell in his review, but not conclusively as having seen meteorites or australites.
6.3 Meteorite Craters

Wolfe Creek Crater (East Kimberley) is the second largest in the world from which meteorite fragments have been removed; the average diameter is 892 m, and the most recent estimate of age, based on modern methods (exposure dating using the cosmogenic nuclides, and optically stimulated luminescence) is approximately 120,000 years (Barrows et al., 2019). While craters can be subject to erosion, Wolfe Creek Crater is reasonably stable due to being in an arid region, so age estimates are possible (ibid). The local Jaru people call it Kandimalal (Goldsmith, 2014). Parke (2019) reported that local people say Kandimalal means no potatoes, since the bush potato doesn’t seem to grow in the area around the crater (source, Ms. Darkie, Kimberley resident of Aboriginal heritage). In interviews with Goldsmith (2014: 457-459), Jaru Elder Jack Jugarie called the place “Muurring” and “Kandimalal”.

There are several creation narratives about the crater. In one, two rainbow snakes crossed the desert and formed the nearby Wolfe and Sturt Creeks, and one emerged from the ground, forming the crater (Bevan and Bindoon, 1993; Goldsmith, 2014, citing National Park signage at the crater). Elder Jack Jugarie described the first star rising up in the afternoon, followed by the moon rising and making the star too hot, so it fell down (Goldsmith, 2014). Jaru Elder Stan Brumby told how bush women lived near the spring soak water in the centre of the crater near sugar leaf trees.

A star man comes and sees that bush women and he wants that sugar leaf so he comes down and that bush women runs away and that star man comes crashing into the earth and takes the sugar leaf and then he went into the earth never to come out again. That women comes back ... There is still a soak water hole in the middle of the crater and the sugar leaf today. (Goldsmith, 2014: 405, citing Yarliyil Art Centre).

Since formation of the crater preceded Aboriginal presence in Australia, the star explanations might intuitive deductions based on seeing ‘falling stars’, or might be European influenced.

Paruka (Lake Gregory) in the Kimberley, like Wolfe Creek Crater, is the subject of a falling star narrative. It is told in the Welcome Paruka brochure (Mulan and Mindibungu Aboriginal Corporations, n.d.), yet no meteoric impact seems to have been recorded for Paruka. This is consistent with an observation by Norris (2016) that falling star impact narratives do not necessarily line up with the existence of craters. The small Veivers Meteorite Crater in WA could arguably be the subject of a star falling narrative since it is relatively young, less than 20,000 years, so the impact might have been witnessed by Aboriginal people (Hamacher and Norris, 2009). Yet, narratives do not seem to exist for it (ibid).

7 THE MAGELLANIC CLOUDS

The Magellanic Clouds are subjects of a number of narratives, including that they are the campfires of old people and places where the dead go (Norris, 2016). For people in the Kimberley they are “lily-roots that exploded whilst being cooked by a creator-being.” (Norris citing Akerman, 2014). Noongar Elder Noel Nannup comments on the importance of Magellanic Clouds for people in south-west WA: “the Small Magellanic Cloud is associated with law and is sensitive and/or secret, and the Large Magellanic Cloud contains “everybody’s” story, and is much more open.” (in Goldsmith, 2014: 69); and “the Milky Way and the Megilion [sic] Clouds are The Seven Sisters Dreaming; it runs a long way down from the Pilbara region.” (in Kerwin, 2006: 69).

Elders Jack Jugarie and Jack Lannigan of the East Kimberley, when interviewed by Goldsmith (2014: 143), gave accounts of a man being speared or people being otherwise hurt; then, “the Small Magellanic Cloud comes down like a misty, smoky cloud over the dead body, and takes blood out of the dead body”. The person comes back to life, and after two or three days returns to the dead state. Goldsmith proposes the initial dead state may be a trancelike state.

In the ‘Two Men in the Sky’ narrative told and sketched by Elder Jack Lannigan, the men are the Large and Small Magellanic Clouds with the Milky Way around them (Goldsmith, 2014: 146). The ‘men’ come down and make a man numb due to wrong-way marriage: “Because he steal your wife, wrong type of marriage. Mulli (in laws) would straighten him out. Two men come out of the Milky Way, two men, he take your spirit away. He keeps you in the Milky Way till you die. That’s finish.”

8 STONE ARRANGEMENTS

Norris (2016) reviews literature on stone arrangements, mainly for New South Wales and Victoria. They comprise small stones and/or large stones. Some have functional uses such as fish traps or indicate direction. Others have ceremonial purposes, including initiation ceremonies. Some seem linked with the night sky including that sight lines from a gap between two largest stones of an arrangement, over outlier stones, go to where the sun sets on the solstice and equinox.

Some stone arrangements in WA are also classified as having functional uses, for example, at “Shackleton there is a circle of rocks on the ground with an added triangle of rocks on the end that points to where permanent water could
be found.” (Noongar Elder Kevin Davis in Wheatbelt Natural Resource Management, n.d.: 7). There is a similar one at Mukinbudin (ibid). Stone fish traps at Oyster Harbour on the south coast, and Denham in the mid-west, are other examples. Hill (2013) identifies standing stones (single and in groups) in the Helena Valley and surrounds, and proposes them to be traditional boundary markers, or associates them with Dreaming narratives, but not with the night sky.

Randolph (2011) describes twelve stone arrangements in the south and mid-west of WA, and acknowledges there are many others. None of the arrangements are identified as being linked to the sky, but one has alignments of stones that extend south, west and north of large granite boulders, and several rocks are placed in trees to the east. The directions of the lines may have been decided using the sun. Schwede (1990) describes stone arrangements in the Helena Valley, Perth, one of which has lines of stones in particular directions – the lines border cairns on the western and northern edges of the arrangement; an Aboriginal informant said it may have been an initiation site.

In an interview by Goldsmith (2014: 516), Josie Boyle, Wongai elder, Eastern Goldfields, spoke about her mother and how her people came together for:

[The]... big Gurandgora, like a big dance, ... It was also for singing, alignment to the stars, and everybody ... brought these rock, from east and west of the land, and the walls are still there, ... these big trenches for dust storm sites, where people sheltered from the dust storms.

Josie mentions that six of the sites are on a zigzag that is matched by stars on a zigzag, and names three sites: Gindowee, Niagra Falls, and Boorley Well. Niagra Falls is potentially the present Niagra Dam, north of Kalgoorlie. I can’t identify the other sites on a map, even with different spellings.

9 ABORIGINAL TIMEKEEPING AND CALENDARS

9.1 Calendars and seasons

The number of seasons recognised by Aboriginal people depends on where they live (Norris, 2016), which is certainly true for WA. For example, six are recognised in Noongar Country in the south-west (Ryan, 2013) and four are recognised by Muludja people in the Kimberley (Davis et al., 2011). About seasons, Norris also observes that, across Australia, heliacal risings of stars, including Pleiades, Vega, Orion, Leo, Scorpius, are recognised as marking seasonal changes.

There are several references to the Pleiades or Seven Sisters in WA accounts that relate to the onset of colder weather and the dingo-pup season. For Ngadjju people, Eastern Goldfields/ Great Western Woodlands, Kupilya ngarrin:

... is the sleeping and hibernating season ... This season is cold and rainy. People are resting up; it’s good for mushrooms. ... the Seven Sisters are in the north-west sky just after sundown to indicate that female jula* (emus) will start egg laying. (O’Connor and Prober, 2010: 36). [* jula may not be the currently accepted Ngadjju word]

“After the emu eggs comes a part of Kupilya ngarrin called the time of the ngurpany, dingo pups (Canis lupus dingo). This is about June, about nine weeks after the dingoes mate.” (O’Connor and Prober, 2010: 38).

For the Pitjantjatjarra people in the Western Desert, which is adjacent to the Great Western Woodlands:

... the appearance of the Pleiades in the dawn sky in late autumn was particularly important as the sign that the annual dingo breeding season had begun. Fertility ceremonies were then performed for the dingoes, or native dogs, and some weeks later the tribe raided the lairs, culling and feasting on the young pups. (Haynes, 2000: 65, citing Tindale and George, 1976).

In the Great Sandy Desert:

The Pleiades, when they were in the sky before dawn ... were seen as a signal of the onset of the coldest nights. According to local myth, the Pleiades women dropped water on the people sleeping below, causing them to shiver with cold. (Johnson, 2014: 42, citing Lowe et, al., 1990).

Emu in the Sky is another seasonal indicator in many places in Australia (Norris, 2016). The different forms of Emu signal: the time (or season) to change camp; and the time for initiation ceremonies. The positions and poses of Emu also indicate: the lifecycle of emus - when they travel to waterholes, sit on them, leave them, when eggs are available and when the chicks hatch (Fuller et al., 2014). Early references to Emu from WA as cited by Fuller et al. (2014) are of a resting Emu, by Aboriginal Groups in the Musgrave Ranges (Basedow, 1925), and an Emu called Kalaia, by Pitjantjatjarra people (Tindale, 1935).
For the Badimia people, Murchison WA: “In autumn, once the nights become colder and following the first rains, the emu in the night sky becomes quite visible. Below the emu is a cluster of eggs. This signifies that the time is right to look for emu eggs.” (Day and Morrisey, 1995: 4). Badimia Carol Dowling, who tells the stories of her great-great-grandmother, grandmother and mother, refers to Emu as Yalibirri, and adds: “Below the emu is a cluster of eggs (known as Wallah). ... This was also the time for dancing as central focus of Badimia practical, judicial and spiritual law.” (Dowling, 2017: 149). Watjarri Elder Olive Boddington (c1940 - 2016), from the Murchison, in Goldsmith (2014: 183), describes the changing angles of Emu:

> When you first see the emu, you don't see the whole of him, just you see the neck and the head part and as the months go by it shapes more into the emu, and then ... it's sort of lying and when it does that that's when the emu's laying eggs and everyone seems to hunt for them then...(the emu eggs) ... special time.

Bulian is reported as another night-sky seasonal indicator - for the Karadjeri, north-western WA (Johnson, 2014: 57-58, citing Piddington, 1930). The:

...change of season from dry to wet ... was seen to be affected by bulian, a great water-serpent. The eyes of bulian were seen to be two stars in the sky. And if bulian was annoyed, it was thought that he would produce change prematurely... The stars in Scorpius were also associated with bulian but set earlier, during the hot-dry season. This change in season took place in mid-December and was regarded as being very significant because it altered economic and social life to a great extent. There was usually no rain from May to December and after that, heavy rains fell during January and February.

9.2 Lunar markers of time

Norris (2016) provides examples where lunar phases and months governed the timing of Aboriginal ceremonies including initiation; and artefacts with marks measured age in lunar months and half moons. WA examples of ceremony being linked to the moon include that, in the north west, prior to the initiation ceremony for boys,

> the women store a large quantity of grass seed, etc., so as to have a supply in readiness for the feast, which is a feature of this ceremony. The families then meet at some given spot, the time being arranged by the stages of the moon, as “new” or “full,” until the company present is of vast numbers. (Withnell, 1901: 10).

For the Mowanjum people in the Kimberley, a halo around the moon “...indicated the time for a boy to be initiated.” (Johnson, 2014: 132. citing Utemorrah et al., 1980). Hassell (n.d.: 191), south-east coast WA, noticed that, for big yardies - the coming together of groups for ceremonies, discussions and trade and marriage, “Some large plains where food and water were plentiful was settled on as a meeting place and they were all together there just before the full moon.”

Withnell (1901: 36) recorded:

> When a death occurs in the camp the men and women throw themselves on the ground, run a few paces ... In memorial they gather round and cry every time that stage of the moon returns, as they mark the time by new and full moon. This is done every month until the season changes ... they know the periods of summer and winter--not only by the heat and cold, but by the difference in the vegetation.
On a different note, the Firestick Ceremony performed by Gija people in the East Kimberley, is performed to welcome the new moon and ensure bountiful hunting (Massola, 2016). The painting held by the Parliament of Western Australia, Seasonal Hunters by Noongar Tjyllyungoo Lance Chadd, depicts Aboriginal men ready to hunt at full moon (Parliament of Western Australia website, n.d.).

Norris (2016) observes that lunar months, unlike seasons are not named. The non-naming resonates with observations of Salvado (Ryan, 2013: 16, quoting Salvado, 1977): “The months are distinguished from one another by the moon, but they are not given individual names, or divided into weeks. Again the days are not distinguished except by the position of the moon”. “Moreover, Salvado noted that Nyoongars reckoned weeks and days according to the moon, but that these smaller divisions of time were not as important as the six seasons in the Nyoongar temporal order” (Ryan: 2013, 17).

An entry in Moore’s (1884: 331) journal indicates that lunar months served as a distance as well as time indicator: “I persisted in my enquiries from the natives about the water to the East. They still say there is a sea in that direction, but far away "Moons plenty dead" is all the information I can get.” On a different topic, Hassell (n.d.: 255) noticed how the Mulga or wizard man who visited:

…had a small irregular piece of white quartz with two tiny specks of gold this had something to do with making the women bear children it was carefully wrapped in bark and wound round with kangaroo sinew and carried in the woman’s Coot [cloak] from full moon to full moon then returned to him when he pronounced some magic words over the woman.

9.3 Timekeeping

For Australia in general:

Other than … using the position of the Sun during the day as guide to the time of day … there are few recorded instances of using the sky to measure time. One exception is the Yaraldi of South Australia, who divided the day into seven sectors … (Norris, 2016: 27).

Macintyre and Dobson (2017a) propose that Noongar people traditionally divided their day into at least nine inter-phasing temporal categories corresponding to dawn, daybreak, sunrise, morning, noon, early afternoon, late afternoon, sunset and twilight. Macintyre and Dobson assign words to the categories, drawing on vocabularies of Lyon (1833), Moore (1842), and Grey (1840). Some words relate to specific times for example, biddorang, biddurong – forenoon, about two o’clock in the day (Moore), and others to time intervals, for example, waullu - light, dawn, daylight, the morning twilight, the interval been light and darkness (Moore).

While the lunar month served as a distance/time indicator for Noongar people (see Section 9.2 above), number of sleeps gave a smaller division of the same. Lyon’s (1833, April 13: 59) vocabulary lists: “beedjar, sleep. This is the term by which they reckon both time and distance. Not so many days; but so many beedjars; that is so many sleeps, or nights; night being the proper time for sleep.” A poignant comment about timekeeping by Wongai Elder Josie Boyle, Eastern Goldfields, was recorded by Goldsmith (2014: 518). Josie was speaking of her mother: “Because every day, my mother couldn’t read or write, so she had to tell the time by the birds, or the sun or the way everything was out in the land.”

10 DIRECTION, SONGLINES AND NAVIGATION

Most Aboriginal navigation skills were used on land - their canoes did not permit ocean travel, except that Yolngu people navigated along the coast; many language groups were fearful of travelling at night, so navigation by following the stars was not a consideration, however a few groups were expert at it (Norris, 2016). An example for WA of navigation following a star is provided by Grey (1841, digital version: April 9, no page number). His exploration party had been unsuccessful in locating water north of Perth: “We therefore continued our search … It was now dark and we soon wandered from the path. Kaiber [the Aboriginal tracker] took a star for his guide and led us straight across the country.” The diary of explorer John Septimus Roe (2014), for the years 1829 –1849 when Roe was in WA, doesn’t seem to mention use of stars by his Aboriginal guides, but does mention many night-sky objects seen by Roe – he was alert to them so potentially would have been alert to his guides navigating with them.

10.1 Aboriginal traderoutes

Trade-routes were interconnected across Australia, were used to trade commodities and pass-on stories, and served to connect Aboriginal people (Norris, 2016). An illustrative example, documented in the diary of Admiral C H Fremantle who landed in Fremantle in 1829 (Cottesloe (ed.), 1979), and more recently by the City of Fremantle et al. (2016), is that Walyalup (Fremantle) was a key meeting place, where Bathers Beach and Arthurs Head Reserve was a Manjaree;
in other words a mun-dja, that is “... a sort of annual fair, which takes place in the spring of the year, when the natives of different districts meet for the purpose of exchanging different articles of utility with one another.” (Grey, 1840: 89). Several trails led to it and gatherings were when food was plentiful. Navigation by the stars is not mentioned in the Walyalup accounts. Neither does it seem to be mentioned in Kerwin’s (2006) thesis on Aboriginal traderoutes in Australia. Possible explanations are that observers and investigators omit to ask about star navigation (Kerwin), or that it is secret information – an explanation that Norris (2016) suggests for other routes.

10.2 Direction

Many Aboriginal groups were familiar with cardinal directions (north, south, east, west), sometimes loosely defined (Norris, 2016). The Guugu Yimithirr language group used cardinal directions to communicate left, right and behind concepts (Norris, citing Levinson, 1997): that is, they predominantly thought in terms of absolute direction rather than relative direction (Levinson, 1997: 98). The Noongar vocabulary by Moore (1842) has words for north, south, east (kakur), west, and “... kangal the east or, more properly, the spot of sun-rising, as it varies throughout the year.” (Moore: 55). Linguistically, kangal is linked to one of the Noongar words for sun (nganga), as Norris (2016) notes for east in other Aboriginal languages. Moore does not describe how Noongar people identified kakur or how they distinguished it from kangal. The Noongar vocabulary by Grey (1840) overlaps Moore’s, but has additional words including kunning, the south-west.

From Moore’s (1842: 23) vocabulary, it seems that the use of cardinal directions to indicate left and right might not have been limited to Guugu Yimithirr people (Norris, 2016), at least in the context of navigation: “Buyal, s.—The south. They always direct you by the points of the compass, and not by the right or the left.” Cardinal directions may have been used more widely (not only for navigation), since none of the Noongar vocabularies by Moore, Grey and Lyon (1833), and the recent compilation by Bindon and Chadwick (2011), have words for left, right, or in front. A Noongar word for behind is listed, but seems to relate to time.

Winds in the Noongar vocabularies are named according to direction: south, south-east, south-west, west; and Nandad “... the east wind; the land wind.” (Moore, 1842: 82). Grey (1840) lists Nangergoon, the east wind. Again, these east words are built from the word for sun. Variations between the vocabularies is explained by pitfalls in recording oral language, and that words differ between Noongar language groups. A reference to direction from Wongai Elder Josie Boyle (Eastern Goldfields) when speaking of the traditional life has no ambiguity: “… simple ways the people had of lovely ways of describing the land, you know. Sunup and sundown. ... Sun down country, see, the sun sets here and the other mob, up there, Sun up, but I was really born in sun up country.” (Goldsmith, 2014: 517).

Moore (1884: 346) also recorded directions in relation to burials:

Then they placed the body carefully in the grave on its right side with the head to the South, the face directed to the East, in which they seemed to be particular. When I remarked this, they said that the people to whom the deceased belonged always buried the bodies North and South, the face looking to the sunrise, but that others buried the bodies East and West, with the face looking to the midday sun.

Hassell (n.d.) observed similar care with the direction that the head faced and the alignment of the bodies: north-south and east-west alignments distinguished burial hill for people and plains people respectively.

10.3 Songlines and Dreaming Tracks

Songlines or Dreaming Tracks are typically believed to have been created and followed by spirit ancestors, and have been followed through the generations, including for trading; songs guide journeys along them so act as oral maps; star maps exist for them but don’t seem intended for navigation; rather star maps seem to be used to illustrate the songs and to act as memory aids (Norris, 2016). Noongar Elder Noel Nannup describes a star map for a Songline in south-west WA (British Broadcasting Corporation, 2017: video). Lines joining five stars are imagined. The map is “almost an exact mirror image” of the route linking five prominent granite rocks on the ground. Of the map’s use, Nannup says only “When you are teaching the children, then you lie flat on your back and look up there [pointing to the night sky].”

Some Songlines are associated with particular constellations including the Seven Sisters Songlines in WA (see Section 4.2 above). Another is the Ululong Songline along the Dampier Peninsular, north of Broome, which is associated with Emu in the Sky (see Section 4.5). Landforms on the Songlines are believed to have been created or used by spirit ancestors who now persist as the constellations or as single stars. For example, “The Minypuru [Seven Sisters] sit down to rest on top of a hill overlooking present day Parnngurr community.” (FORM, 2018, no page number). This statement is for the painting Parnngurr, 2014, by Bugai Whyloulter (c1939 - ), Great Sandy Desert, who grew up living a traditional nomadic life (Martumili Artists, n.d.). A second example is that Marala the Emu man (Emu in the Sky) left three toed footprints on the rock platforms of the Dampier Peninsular (Salisbury et al., 2016). A third
example is that, to create the Milky Way, the Charrnock Woman used Wave Rock on the W in the Sky Songline to leave Earth (Nannup, 2008). In numerous other Songline narratives, landforms are associated with stars but, like the narratives cited here, I haven’t found any that hint of stars being used for real-time navigation between landforms.

The interview by Goldsmith (2014: 520-521) of Wongai Elder Josie Boyle, Eastern Goldfields, speaking about her mother provides navigation detail:

... and they did lots of journeys ... straight across the Nullarbor where the railway line is today. ... That was the walking path of those people, my people, that walked from (Ombi?), long time ago, for ceremonies for star stories and star aligning stories ... That's how we got walking paths ... where they were going to their ceremonies, for the Guarnadagas and the singing songs of the alignment of everything, see, of the earth and the sky. ... and that's what she talked about all the time see, and see she drew these things in the sand.

Did ‘these things’ drawn in the sand represent objects on earth, or stars in the sky, or both? Were the drawings sand maps?

11 ROCK ART

Norris (2016) addresses rock engravings and rock paintings in two sections of his review, and identifies astronomical links for both. The two art forms, as they occur in WA, are considered only briefly in this section. There are 452 painted/stencilled motifs in Bates Cave, also known as Mulga’s Cave, near Hyden, south-west WA (Gunn, 2006). Mulga was the man of the Charrnock woman who created the Milky Way (see Section 4.3). The motifs are carbon dated at 500 years but many motifs are superimposed others which Gunn suggests might be older. Gunn (2006: 38) suggests also that the large Geometric designs “... most likely refer to the Dreaming tracks.” He makes no link with night-sky objects. The hand stencil in Dales Cave, near Perth close to the Avon River, has been described in Section 3.2 in relation to the Moon.

Gunn et al. (2011) describe the Kybra petroglyph (engraving) site, south coast WA, on horizontal limestone sheets that are open to the weather. There are 240 motifs, predominantly of emu and kangaroo foot-prints. There is one star, length 24 cm.

The Seven Sisters Songline that crosses the Pilbara and finishes in South Australia is painted on the walls of Walinyna (Cave Hill), near Amata, Musgrave Ranges, South Australia (MacFarlane and McConnell, 2017). It includes many concentric circles and tracks. My web search did not reveal literature describing the painting as a map. The Songline is also pecked (engraved) into the rock at the Kuli waterhole, Musgrave Ranges, South Australia (MacFarlane and McConnell, 2017, citing James, 2009). Other rich rock art sites in WA have not been considered for this review including the aggregations of painted Wandjina spirits and Gwion Gwion (Bradshaw) figures in the Kimberley, rock engravings on the Burrup Peninsular in the Pilbara, and rock engravings in Port Hedland (the Pilbara) at Burgess Point, Mourambine Kariyarra and South West Creek.

12 CONCLUSION

My review of the night-sky knowledge of Western Australian Aboriginal Peoples provides examples from Noongar culture that counter a claim that, traditionally, Aboriginal people did not count past four. The counting examples follow similar identified by Norris (2016). Other references indicate that night-sky knowledge was used for practical purposes in Western Australia: particular stars were recognised as being seasonal indicators; and time was defined by lunar phase, lunar months, and by the nature of sunlight, for example twilight; but most commonly by season. Navigation using a star as a guide was not unknown, and star maps were used to teach Songline routes, but I have not identified any media (documents, audio or video) which state that star maps were used in real-time navigation of Songlines. There is Noongar language for cardinal directions, for the spot where the sun rises, and for winds by direction, but I did not uncover precise methods for determining direction.

A number of narratives indicate Aboriginal peoples’ beliefs. That the Earth and Sky were one, in the cold time, then the Sky was lifted up; or the Sky is a canopy meeting Earth at the horizon. That the Sun is the giver of life; and there are various beliefs about where the dead reside. That planets differ from stars and have magic powers. That the Magellanic Clouds provoke death. Meteors and comets were seen, but may not have been distinguished, and were considered bad omens. Tribal doctors carried stones which might have been tektites, or the category of tektites called australites – they were used to call for rain and cure people, amongst other things.

Other narratives with night-sky subjects convey a moral, for example, the man who opted for ‘wrong-way’ marriage became the Moon; and some are creation narratives of landforms, for example, Marala the Emu man (Emu in the Sky) made three toed footprints on the Dampier Peninsular. Several narratives premise the creation of night-sky objects, for example, the Southern Cross, while others explain events, for example, a solar eclipse. In fact, many
of the narratives could be interpreted from several perspectives – as conveying beliefs about creation, moral behaviour and events.

My search for references was, in most part, internet-based and was limited mainly to freely available works, so cannot be considered comprehensive. It did not reveal anything, or very little, on several topics considered in the Dawes review (Norris, 2016), namely lunar eclipses, Orion, Scorpius, most of the planets, and stone arrangements. It could be that these topics are ripe for future research in WA. I made personal inquiries about stone arrangements and made little headway. Perhaps the information is secret per se, or men’s knowledge. The sighting and beliefs about aurora and supernova are not included in the review.

Neither did I consider rock art to any great extent. It is a huge topic for Western Australia, and I suggest warrants inquiry from a night-sky perspective. Further investigation of non-digitised early records, and of acrylic paintings and statements by Aboriginal people who carry traditional knowledge, would likely reveal more on many topics in this review. The topic that draws me most is the Seven Sisters Songline through the Eastern Goldfields. Where did the sisters go in addition to the places uncovered so far? Did the Goldfields Songline connect with the Seven Sisters Songline through the Pilbara? There are leads to pursue.

13 NOTE
The typed title page of Ethel Hassell’s journal, ‘My Dusky Friends, Sketches of the South Eastern Natives of Western Australia, Some of their Legends and Customs’, does not include a typed date. It is dated in the literature as Hassell (1861-1910). In 1861 Ethel was five years old, and she didn’t live with her ‘Dusky friends’ until at least 1878. So, in this review, I reference the journal as Hassell (n.d.). The page numbers that I provide are the pencilled page numbers in her journal in the Mitchell Library, Sydney – an electronic copy is available online.

14 ACKNOWLEDGEMENTS
I acknowledge and pay respect to past and present Aboriginal peoples who have shared their night-sky knowledge, and respect the right of others who have not done so. I thank WA Inspired Art Quilters for our projects connected with Aboriginal culture, which led to my inquiry into Aboriginal night-sky knowledge. I thank Ray Norris for his encouragement to publish, John Goldsmith for his critical review, and Marianne McLaughlan for critical feedback on cultural protocol.

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32


Granite Outcrops

Statement: Granite outcrops are sites for fresh water, animals and plants that rely on water, ingenuity by Aboriginal people in the collection of the water, and rock art and ceremony.

Text on the quilt
- Dreaming narratives, ritual, ceremony, gender specific or shared
- Gnamma...rockholes; formed by weathering, fire, pounding; pit and pan shapes; cleaned and covered
- soaks with wells, flora, fauna...pit traps
- stone arrangements
- rock art
- navigation markers, key points on songlines
- grinding patches for seed and ochre, slab shelters and lizard traps
Review of Aboriginal Culture in Relation to Granite Outcrops, a Western Australian Focus

1 INTRODUCTION

This review about Aboriginal culture draws mainly on references relating to Western Australia (WA). Most refer to Noongar Country which is in the south-west of the State. Noongar Country is approximately triangular with boundaries from Geraldton down the west coast to Augusta, east along the south coast to Esperance, and the third side of the triangle goes from Esperance to Geraldton. Noongar Country has fourteen language groups which are distinguished in the review when language groups are available for references, for example as Whadjuk Noongar, Menang Noongar. Other major groupings referred to, each with multiple language groups, are peoples of the Eastern Goldfields, the mid-west (Murchison and Gascoyne regions), north-west (the Pilbara), north (the Kimberley), and the Central Deserts. To locate the territories of all language groups in WA, the reader can view, online, the map by Tindale (1940) and a simpler version by the Australian Institute of Aboriginal and Torres Straight Islander Studies (1996). The spelling of Noongar and other names in the review varies – each version matches that in the papers from which the names were retrieved.

Facts about, and uses of, granite outcrops are included as well as cultural narratives. My intention was that cultural references would relate to traditional, pre-European settlement culture. However, whether or not current accounts by Aboriginal people reveal knowledge which is free of European influence is a moot point: narratives evolve over time, in the oral tradition and by different speakers, and sometimes take in contemporary conditions (Maranda, 1972). In particular, narratives reclaimed by Noongar Elders, after the cultural impact of several generations of stolen children, may differ from those told pre-European settlement. Another contingency is that recorders and researchers may overlay their own world views when collecting and interpreting data.

The review is presented under seven headings: ‘Granite outcrops defined’, ‘Gnammas and soaks’, ‘Granite outcrop utilisation by Aboriginal people’, ‘Flora and fauna’, ‘Songlines, ceremony and Dreamings’, and ‘Art and artefacts’. The process of collecting references has made me realise that Aboriginal culture in relation to granite outcrops is a huge field on inquiry that I have barely touched.

2 GRANITE OUTCROPS DEFINED

From a scientific viewpoint, “granite domes – also known as inselbergs or monadnocks – are a conspicuous geomorphological feature of many Australian landscapes and can comprise large monoliths rising hundreds of metres above the surrounding landscape, to low platforms barely higher than their surroundings” (Harvey, 2010, p. 26).

From a Noongar Dreaming perspective, a spirit woman once walked on earth and she collected little spirit children from the landscape and put them into her hair before she became the Milky Way (Nannup in Morgan et al., 2008). As she travelled around, some of the children fell from her hair to the ground and turned into stones. … however, some of the children had also turned themselves into birds, and were swooping and pecking around her as birds sometimes do. Because of that she stepped away from them and on to one great big stone. It toppled over; and when it hit the ground it crashed across the southern part of the land and formed the great outcrops of stone that you see all through the south. Nyungar people know these stones as bib, which means breast. So Bibbelman is the land of many breasts. That is what it [Bibbelman] means (ibid, p. 100-101).

Gnammas and Soaks

3.1 Gnammas

Gnammas are natural cavities commonly found in hard rock, particularly granite outcrops, and as such act as natural water tanks (Western Australian Museum, n.d.). More simply they are rock holes. The word gnamma is widely used in Australia and the first published version of it is said be in Moore’s (1842) Noongar vocabulary (Bindon, 1997, citing Wilkes, 1978). Two entries in Moore’s vocabulary are relevant: “Water, standing in a rock—Gnamar” (p. 167); and “Amar—A hole or pool of water in a rock. In many parts of the country, where there are no rivers nor springs, the water from the winter rains is retained in deep crevices or holes worn into the surface of the rock. These reservoirs are carefully noted, and are relied upon as the principal resources of the natives, in dry and rocky situations, during the summer months” (p. 2).
Another early account of gnamma is that of Austin, an explorer, although he did not use the word gnamma. He had held an Aboriginal man captive for the purpose of finding water in the Murchison. The man led the party to a water hole where rainwater had accumulated (Bayly 1999, citing Austin, 1856).

The holes or cavities form naturally, initially. A depression in the rock starts through “moisture attack” (Bourne and Twidale, 2002, p. 87) and “sun exposure causing flaking, breakdown of crystalline irregularities, lichen attachment, attack of acid groundwater on bedrock” (Wheatbelt Natural Resource Management, n.d., p. 15). Next, the rock breaks up, with the most accepted explanations being alternate wetting and drying; other possibilities include continued sun exposure, xenolith (bits of foreign rock) attack, and the direct action of wind and running water (ibid). Then, the debris is evacuated—the broken rocks “get taken away by wind, get dissolved in solution, or are removed by people” (ibid).

Some gnammas have been enlarged through human or animal intervention. The Derdibin gnamma, at the base of Derdibin Rock, Balladong Noongar Country, “has a rough hemispherical shape ... that formed along three joints in the rock which acted as weaknesses. The rock rotted in those particular areas, perhaps helped by some Aboriginals digging and burning” (Wheatbelt Natural Resource Management, n.d., p. 16). “The people used to heat the rock up and keep pounding it until it got deep enough so that they could have a water hole” (Noongar Elder Kevan Davis in Wheatbelt Natural Resource Management, n.d., p. 8). Bayly (1999) writes that:

It is thought (e.g. Jutson) that both animals and Aborigines played a significant role in the enlargement of some gnammas by scratching debris and weakened rock from the bottom and sides while tapping the last vestiges of water. Further, Tindale & Lindsay (1963) pointed out that Aborigines sometimes diverted water into a gnamma by chipping grooves in the surrounding rocky slopes (p. 20).

“Some Noongar stories say gnammas were created in the dreamtime by the Wargal, the spirit snake that also made the rivers, lakes and wetlands. Another dreamtime story says that the row of five pit gnammas in Trayning were dug by a nyinjarn (echidna) digging pits as he migrated south” (Noongar Elder Kevan Davis in Wheatbelt Natural Resource Management, n.d., p. 8).

3.2 Gnamma size and shape

Gnammas are classified into two basic forms: pans and pits. Pan gnammas are diverse in shape, shallow, flat-floored and seasonally fill with water (Timms, 2013). They “develop in laminated granite which allows more lateral rather then vertical moisture attack”, while pit gnammas “form in massive isotropic rock” (Bourne and Twidale, 2002, p. 88), that is rock with uniformity in all directions. Pits are subcircular, have a depth to diameter ratio exceeding 0.2, and contain water for longer periods (Timms, 2013, p. 7, paraphrased).

Timms (2013) investigated gnammas in the Wheatbelt (Noongar Country) and Eastern Goldfields districts of WA, in particular, 80 pit gnammas. He found that: “most granite rock outcrops ... have numerous shallow pan gnammas generally on the flattish upper parts of the dome, but some rocks have single or a few deep pit gnammas often on the lower flanks” (p. 7). “The pit gnamma varied in mean diameter from 0.19 to 12 m and in depth from 24 to 300 cm” (p. 9). The majority of pit gnamma “were 1.0–2.5 m in mean diameter and 50–100 cm deep” (p. 9). Extreme cases included the 12 m diameter gnamma on Beringbooding Rock, and the 3.8 m-deep gnamma at Cadigan.

Most pit gnammas investigated by Timms (2013) had hemispherical to parabolic pit shapes. Some were cylindrical. Quite a few were on major vertical joints, and were “elongated along the joint, often narrowing at each end to give an overall ‘canoe’ shape” (p. 9). Some were formed on a major joint between two rock blocks so were like a trough. Two had an underground shelf and one was flask shaped. Many rims had minor joints and laminations.
Pan gnamma within a pan gnamma, the secondary gnamma (darker patch, left side of large gnamma) has eroded in the floor of the larger basin, McDermid Rock, Holland Track, south-west WA, photo by Pat Forster 19/10/2007

Hemispherical pit gnamma, Kalbarri National Park, mid-west WA. Photo by Pat Forster 09/06/2018

An underground shelf can develop where “pits have penetrated through the base of a slab or sheet structure - runoff entering the pit flows through the base, a swirling action develops and a cylindrical hollow forms” (Bourne and Twidale, 2002, pp. 87-88). There is a large example at Beswick Rock, near Corrigin, in Njaki Njaki Noongar Country, “some 6 m long and 3 m wide and at least 2 m deep” (ibid, p. 88). Two other pit types not found by Timms (2013) are armchair hollows which are found on steep slopes, have “open downslope sides” (Bourne and Twidale, p.87), a steep upslope side, and so are shaped to suit the name, and pipe ganmmas which are narrow, deep pits.

An early sketch of gnamma appeared in the first annual report of the Western Australian Department of Mines in 1894:

The sketch is in two parts. The top half shows a natural landscape with trees in the background and three Indigenous people approaching a large rock, in the centre of which is a depression containing water. The bottom half shows a cross-section of the depression, revealing it to be a deep hole capable of holding water. ... The drawing was included in a government report for the benefit of gold prospectors flocking to WA’s eastern gold fields... A gnamma was often a more important and welcome find to prospectors desperate for water than the sight of gold itself. .... With the coming of thousands of non-Indigenous people to the eastern gold fields, water in gnammas changed from being nurtured and used carefully to being traded for a profit. Indigenous people, who were not part of the market economy, suffered greatly (Learning Federation, n.d., webpage).

Göczel, 1894, black and white sketch, from the 1894 report of the Western Australian Department of Mines Source National Trust of Australia (WA) Western Australia, http://www.ntwa.com.au/

The Narkeening Gnamma Hole, north east of Nungarin in the south west (Njaki Njaki Noongar Country), is:

historically important as an example of Aboriginal adaptive use of environment... Early in 1999, a search was conducted to discover a gnamma hole of sufficient size to warrant inclusion on early maps. Barry Cornish
discovered the main hole ... It was completely filled with dirt, numerous rocks, and remains of bush timber, and was barely able to be discerned from the surrounding area. Once excavated, the hole proved to be more than 6 feet deep, and of considerable capacity. The smoothly irregular shape of the hole bears testimony to the method of construction, with hollows that suggest that fires had been lit to crack the rock. Some of the cavities were part the way up the walls of the gnamma hole, and water from the lower cavities would have been available to splash on to the hot rock to assist the process of cracking and flaking. In Barbara Sewell's "Goomalling - A Backward Glance", the author describes the aboriginal method of lighting a fire to heat the rock, and successively chipping away to form a hole (Shire of Nungarin, 1999, webpage).

In an analysis of gnamma in multiple locations including across WA, Fiedler and Hopper (2016) classify groups of gnamma as riverine, where water flows between them when they flood, or as a gnamma complex, where several are close to each other on a relatively flat surface; and describe gnamma hydrologic-functions as surface and shallow subsurface water-storage and exchange, and as landscape hydrologic-connections, that is water movement connections such as from a granite outcrop to a soak. Other functions identified by Fielder and Hopper include the support of humans, flora and fauna and the cycling of elements and compounds.

Riverine pan gnammas, Wave Rock, south-west WA, photo by Pat Forster, 30/07/2019

Gnammas along a vertical joint, canoe like, riverine grouping, Whaling Cove, Torndirrup National Park, Albany, south coast WA, photo by Pat Forster 25/02/2020

3.3 Gnamma maintenance

As a general principle “it is the right and responsibility of Nyungar to care for boodjar [country]” (Stocker et al., 2016, p. 849). This would have included gnamma. Further, “Water kept our people alive, so gnammas were sacred. They were guarded and regularly cleaned. Slabs of rocks were placed over some smaller pit gnammas to reduce evaporation and prevent wildlife from falling in and drowning” (Noongar Elder Kevan Davis, in Wheatbelt Natural Resource Management, n.d., p. 5).

“There are several reports of Aborigines (and later European pioneers) covering gnammas with branches or flat slabs of rock to cut down on evaporation, and to keep out wild animals which not uncommonly fell in and drowned, and thus polluted a precious supply of water” (Bayly, 1999, p. 20). “To prevent animals getting at the water, most of
the rock-holes are partly or entirely filled with loose lying sticks, which practice, necessary as it may be to save the water, deteriorates its quality considerably by making it often look quite black and giving it a fetid smell and taste” (Helms 1892:253). … Aboriginal people have indicated to me [Bindon] that the sticks allow animals to reach the water, drink and climb out of the hole without being stranded and dying by drowning. The sticks thus prevent contamination by animal carcasses” (Bindon, 1997, p. 174).

3.4 Soaks and soakage wells

Bayly (1999) offers the definition “Soaks (native wells); water that seeps into hollows in freely permeable sediments” (p. 20), and that “So called “native wells” or “native soakage-wells” were commonly holes dug into sand or soil lying next to the point where a sloping surface of hard, impermeable rock disappeared beneath a flat plain. The upraised rock surface serves as a rainwater catchment and the run-off soaks into the soft sediments surrounding it” (p. 20).

Moore’s (1842) vocabulary indicates Noongar people had language which distinguished between water standing in a well (gnura) and water standing in a rock (gnamar). They also had a narrative explaining the existence of a soak in the Kojonup district.

The country was gripped in drought and the only known water was salty. The health of the parched Aborigines, birds and animals deteriorated. An eagle-hawk, soaring about the sky and swooping to earth, observed that a fat and shiny crow had a wet beak, wet with fresh water. The eagle-hawk, seething with unparalleled fury, attacked the cunning crow. In so doing his claws split the rocks and the blood of the attacked crow was splattered over the surrounding rocks and earth. So, a freshwater soak is to be found in the Wakhinup area, hidden amid rocks and surrounded by rich, red loam (Goode et al., 2008, p. 14, citing Bignell, 1971).

Roe (1852), on his 1848 – 1849 exploration south-east of Perth, was relieved to find a soak after a period of having existed with little water:

our poor horses could do no more, and were gladly conducted ... to their promised rest and feed. Here, however, not a blade of grass rewarded our minutest search, and only a few pints of water were lodged in holes in the rock. Some flags and coarse rushes occupied the place of better feed, and among these the horses were tethered to do their best, water being fortunately found by digging near the N.E. foot of the granite rock (Nov 17, 1848, diary entry).

Roe’s diary, of his exploration east of Perth in 1836 (Hercock (ed.), 2014), offers several descriptions of what might have been soakage wells at the base of granite outcrops. For example:

... halted to SE corner of granite ridge of C, where excellent grass in great abundance & a grassy well of pure water 6 feet in diameter and 18 inches deep ensured a good time for our horses. The neighbourhood seems to be of the same good description for a considerable distance around. ... and near the well (which is in the bed of a small winter drain dripping to the SE) we disturbed a pair of white cockatoos (pp. 263-264).

On the same journey, Roe recorded: “When the wells fell into disrepair, people would bail the well, using the coolammon to throw slush against the wall. This would set like a cement wash and help to hold loose sand, preventing it from falling into the water” (Hercock (ed.), 2014, p. 265).

Between 1864 and 1866 explorer Charles Cooke Hunt “cleared a track to the East [from York, east of Perth, towards the Eastern Goldfields] sinking wells at convenient intervals. The wells were generally located at the base of granite outcrops, sites well known to the aboriginal people as sites of water” (National Trust of Australia (WA), 2002, p. 40). Maybe the sites that were known to Aboriginal people were soaks, perhaps with wells they had dug.

Bayly (2002) identifies other examples of appropriation of water sources relied on by Aboriginal people. Often it was to water thirsty horses, which drank a lot, and/or camels which drank even more. The water was needed by Aboriginal people for their survival, and the quantities consumed were immense in relation to the amount of water available (ibid). Webb (2007) describes watering places used by Afghan people and others at Afghan Rock, Camel Soak, and Djungari (Bald Rock), all near Cue (mid west WA), and suggests they were potentially developed from native soakage wells. David Carnegie’s party, on their inland trip from Coolgardie (Eastern Goldfields, WA) to Halls Creek (Kimberley) and return 1896-1897, engaged in soak sucking – a “process of repeatedly digging out soakage wells and bailing out every skerrick of water that seeped inwards” (Bayly, 2002, p. 44). Another problem was explorers camped beside the water sources, rather than away from them - which allows animals to come in, so Aboriginal people were also deprived of a food source (Bayly). In some cases the Aboriginal people retaliated and then were punished for that.

Other than a few references to soaks in the desert, without descriptions, I have found few other references to soaks or native wells in literature for Western Australia. One reason, perhaps, as voiced by a Noongar consultation
group about regional water: “Natural water sources/soak water/wells no longer accessible or damaged, e.g. well between Williams & Narrogin – Geeraling (also sacred site, birth and burials)” (Goode et al., 2008, p. 46). Without maintenance, soak-wells could disappear quickly. Replacement with European wells, and retention of their European history without acknowledging their origins is another issue.

Soakage water rising onto Emu Rock, Holland Track, south-west WA, photo by Pat Forster, 01/10/2007

Hidden soak, front right by flannel bush, Wooleen Station, mid-west WA, photo by Pat Forster 05/09/2004

4 GRANITE OUTCROP UTILISATION BY ABORIGINAL PEOPLE

4.1 Grinding patches

Grinding patches can be defined as “rock pavements or slabs worn smooth by Aborigines grinding on their surface. They are most commonly found in arid regions, where Aboriginal people, especially women, carried out seed grinding” (Webb, 2007, p. 115, quoting Flood, 1990). “Residue analysis has shown that some grinding hollows were used for pulverising ochre and some for grinding up food substances such as hard fruits” (Webb, p. 115).

Goode et al (2005) recorded multiple grinding patches/holes in the Albany local government region, close to or on the south coast of WA: one at each of at North Point, Cheyne Beach, Sweep Rock, Mutton Bird Island (close to shore), another near Mutton Bird Road on the mainland, four at Two Peoples Bay, and one slightly inland on a granite cap on the banks of the Kalgan River. Goode concluded:

Grinding patches represent base camps and suggest the presence of women and family groups. Grinding is associated with food processing, grinding ochre and resin or sharpening wooden implements. On the other hand grinding patches on the coast may have been utilised for burly to assist spear fishing which is a male hunting task (p. 29).

Archival research indicated that grinding patches on the coast supported fishing. Goode also warned that the grinding patches “are highly vulnerable and are subject to erosion and inundation, particularly with climate change and a rise in sea level” (p. 193), and recommended further recording and monitoring of the sites.

Webb (2007) investigated 43 grinding patches at six sites within a 50 km radius of Cue (mid-west WA). They were very shallow (< 1mm deep) and ranged in size “from 150 mm x 100 mm to 750 mm x 600 mm” (p. 119). They were all
near gnammas or soaks. At Camel Soak, grinding patches were near petroglyphs on open granite pavement. The presence of the petroglyphs, and observations by Tyndale about seed grinding, allowed inference of cultural associations. “In the Pilbara, grinding is associated almost exclusively with petroglyphs. A few sites with both pictograms and petroglyphs are known, but none with only pictograms” (p. 122-123).

Tindale (1974) showed the area where grass seed flour was an important element in Aboriginal diets, his Panara culture, spreading across the inland Pilbara as far south as the area around Cue. He said the people of the Murchison region, who now call themselves Yamaji, were the southwestern-most people to extensively exploit grass seeds and wet-grind them for the making of forms of bread. The grinding patches on bedrock recently found around Cue support Tindale’s contention that the Yamaji ground grass seeds; suggesting they were more closely linked socio-economically to people in the Pilbara than they were to the Noongar to the south. Noongar people did not grind grass seeds; they seem to have relied on tubers as their carbohydrate staple. The Yamaji also ate tubers, of course (Webb, 2007, p. 121).

Hopper et al. (2016) identify 21 ‘wilgi gnamma’ (red ochre pools) in Noongar country, south-west WA. Webb describes another at Mount Ridley, 65 km north of Esperance, in the south-west. The Mount Ridley gnamma seems to have been used exclusively for grinding ochre (Webb, citing Smith, 1997). The wilgi gnamma are typically at the top of granite outcrops with extensive views, but no oral history has been recorded about them (Hopper et al.). Hopper et al. pose the question as to whether or not they were used in preparation for ceremony.

4.2 Rock shelters

Schwede (1990), as part of an archaeological dig in the Helena Valley area near Perth (south-west WA), identified a “Stone arrangement and chalk pit. Quicke’s Property. Paulla Valley … This includes the granite stone arrangement on a hillside at the northern end of Quicke’s property listed by the Aboriginal Sites Department … and is considered by the sites Department to be a ‘hunting hide’ ” (Schwede, 1990, p. 103).
Goode et al (2005) describe the ‘Lake Pleasant rockshelter’ near Albany on the south coast WA: “The site is a rock shelter located halfway up a granite outcrop on the edge of a small amphitheatre with a northwest aspect overlooking Lake Pleasant View East (p. 138). Archaeologist, Sally McGann “found a fire hearth within this rock shelter where she obtained a date from a burnt turtle shell” (p. 138). Other archaeological finds near the site include artefact scatters, gnmmas and loose slabs of granite that may have been lizard traps.

Goode et al. (2005) also describe a natural rock shelter or cave, known as a ‘Waugal trap’, or snake trap, on Mount Melville in Albany, south coast, WA. “The site is an area of large granite boulders that forms a cave that is located on a north west facing peak on the northern end of Mount Melville. ... Ms Lynette Knapp the primary informant for this site said that this is the location of the Snake Trap that the mythical Menang built in order to catch two Waugal who were fighting each other” (p. 95). See the last paragraph of Section 6.1 below for the Menang Noongar narrative.

Archaeologists working on the Dampier Archipelago, in the north west, have found evidence of stone houses, dated to the end of the last ice age (around 9,000 years ago) (Crofts, 2016). While exploring one of the Archipelago’s 42 islands, the team discovered knee-height rock walls. “Excavations on Rosemary Island, one of the outer islands, have uncovered evidence of one of the earliest known domestic structures in Australia, dated between 8,000 and 9,000 years ago,” said lead researcher Jo McDonald, from the University of Western Australia” (ibid, webpage). While granite outcrops exist in the area, the reports about the houses do not identify the type of stone used. The stones comprise small sharp edged boulders, not slabs of granite as are used for shelters the south west.

A search (18/03/2020) on the Aboriginal Heritage Inquiry Service WA brought up 77 registered sites with rockshelter in the title, but no descriptions. Bindoon (1997) warns:

“Although structures interpreted as hunting hides or perhaps the walls of semi-permanent shelters can be found on the surfaces or in the surrounding scree slopes of granite domes in the north of Western Australia, these constructions cannot be considered as typical of Aboriginal activities on granite domes. Using loose tabular pieces from weathering processes, windbreaks can be made fairly quickly, particularly if some brushwood is incorporated into the structure. Lack of archaeological remains other than the walls in these structures hinders their exact interpretation (p. 176).

4.3 Lizard traps

On a number of granite outcrops in the south-west, features called ‘lizard traps’ can be found. These take the form of a rock plate or slab up to about a metre in diameter that is propped up along one edge by a number of other rocks so that it lies at a slant. As there is no possibility of the top rock falling and holding the lizard, we can assume that these were not true traps. However, they may be purposefully built especially to encourage sustained lizard populations on selected rock exposures by providing protective habitats. One presumes that establishing environments like this ensured the visiting hunter of a supply of animals on recurrent visits. It has been observed that when disturbed away from cover on these rock exposures, and given an opportunity, lizards or any small game run directly to the dark shelter of these slanted rocks. Regrettably, there is no evidence from ethnography confirming the function of these rock structures (Bindon, 1997, p. 175).

Hopper et al. (2016) explain the presence of lizards on granite outcrops and the construction of lizard traps: “relatively infertile Ocbil soils on granite select for animals with specialized and conservative metabolisms (ectotherms e.g. reptiles). Specialized husbandry [such as providing shade by constructing ‘traps’] of scarce palatable reptiles on granite Ocbils is predicted as a cultural adaptation” (p. 8). Menang Noongar Elder Lynette Knapp, south coast, “described the deliberate cultivation of a particular plant species, Hakea drupacea (Proteaceae) at the edge of granite outcrops in the Albany area as a means of enhancing granite exfoliation to gain flat slabs for use in lizard trap construction” (Lynette Knapp pers. comm. 2014 in Lulfitz et al., 2017, p. 212). Hopper et al. note the widespread presence of lizard traps in Noongar Country, south-west WA, and a little beyond.

Goode et al (2005) describe several sites within Albany local government area on the south coast that have lizard traps. One site ‘Eastern Granite Outcrop’ near Quaranup Road, Torndirrup Peninsula has three lizard traps, a gnamma hole and a stone arrangement. Another site ‘Northern Granite Outcrop’ near Quaranup Road had five lizard traps but only one remains – slabs from the other four had been taken for garden ornaments or some such; some other traps are within Mount Melville. The traps provide evidence that the places were used to gather resources (ibid). Webb (2007) describes a lizard trap on granite at Taincrow Rockhole near Cue in the Murchison, mid-west WA, where there are also gnamma and grinding patches.

A search (17/03/2020) on the Aboriginal Heritage Inquiry Service WA supports the view that most lizard traps are found in the south west (Noongar Country): all five ‘registered heritage’ lizard traps and 14 ‘other heritage’ lizard traps are in the south west, in southern or wheatbelt regions. Two are in Fraser Range in the Eastern Goldfields Region.
4.3 Stone arrangements/signs

“Stone arrangements often mark ... ritual places. The constructions, formed from slabs and other weathering products from the inselbergs, take the form of a ‘W’, are erected as a sinuous line or may be piled into a series of scattered mounds. Although the particular ceremonies carried out at these places cannot be detailed, it can be assumed that these features represent aspects of landscape and are connected with initiation procedures” (Bindon, 1997, p. 175). Schwede (1990) provides an example consistent with Bindon’s observation - a standing stone site at Nyaaania Creek in the Helena Valley near Perth: “Stone arrangement ... The site overlooks the Swan coastal Plain to the west. The granite arrangement contains stone cairns and lines of stone. The latter border the cairns on the sites western and northern edges, extending down the hill on the northern flank of the granite outcrop to Nyaaania Creek” (p. 100-101). “The stone arrangement at Nyaaania Creek was shown to an Aboriginal spokesperson and though he did not have knowledge of this particular site, he stated it could have been used for initiation ceremonies in the past” (p. 107).

Other stone arrangements in WA have practical uses, for example, at “Shackleton there is a circle of rocks on the ground with an added triangle of rocks on the end that points to where permanent water could be found” (Noongar Elder Kevin Davis in Wheatbelt Natural Resource Management, n.d., p. 7). There is a similar one at Mukinbudin (ibid). Hill (2013) identifies standing stones (single and in groups) in the Helena Valley and surrounds and proposes they are traditional boundary markers, or associates them with Dreaming narratives.

Randolph (2011) describes twelve stone arrangements in the south and mid-west of WA, and acknowledges there are many others. His focus is description, not interpretation. They comprise granite standing stones in short and long lines, lines joined with loops, meandering lines extending towards cardinal directions, circles, an ellipse, Vs and Ws, and a spiral. Goode et al (2005) describe two others on the south coast, one near Quaranup Road on the Torndirrup Peninsula near Albany and the other near Mutton Bird Road, east of Albany. Both arrangements are circular.

5 FLORA AND FAUNA

5.1 Flora

The run-off that provided surface water in gnammas, also permitted other forms of life to flourish on, but mainly around the base of, the inselbergs [island-like granite]. This is not to deny the significance of the various plants and animals colonising the rock surface itself, but few of these were important for Aboriginal people except through the contribution they made to the life of the higher plants and larger animals usually hunted as game. Various plant species favoured the rim of rocky outcrops, exploiting the zone where run-off from the all too rare rainfall was concentrated. Two very important trees to arid land dwellers, Kurrajongs (Brachychiton gregori F Muell) and Quandongs (Santalum acuminatum (R Br) D C) are commonly found around granite outcrops. They provide fruit, wood and sometimes medicinal products for Aboriginal people... medicinally important Rock Isotome, (Isotoma petraea F Muell) and the Adjikoh or Warrain (Dioscorea hastifolia Endl in Lehm), a staple yam species, also favour granite outcrops. If for no other reason, Aboriginal people visited granite domes to exploit these resources (Bindon, 1997, pp. 174-175).

There are several explanations for species associated with granite outcrops. For example, “the isolation of ancient granite outcrops and gnammas within the landscape has contributed to the evolution of endemic species. ... WA granite outcrop endemic plants include Caesia Gum (Eucalyptus caesia), Silver Mallee (E. crucis) and Granite Kunzea
(Kunzea pulchella). Special habitats like gnammas and ancient granite outcrops are just one of the reasons Australia has such a rich variety of unique plants and animals” (Wheatbelt Natural Resource Management, n.d., p. 18).

The range of species is huge, especially in Noongar Country in the south-west:

At least 1320, and possibly 2000, plant taxa occur on Western Australian granite outcrops. Outcrop plant life is most diverse in the South West Botanical Province, with individual outcrops having up to 200 species, including many endemics not found in surrounding habitats. Species richness and local endemism declines with increasing aridity, to the point where Kimberley and Pilbara outcrops show little discontinuity in species from the surrounding landscape matrix. Outcrops are dominated by woody and herbaceous perennials, especially of the Myrtaceae, Orchidaceae, and Mimosaceae, and have an unusually rich diversity of annuals (Asteraceae, Stylidiaceae, Poaceae, Amaranthaceae etc.) compared with the flora as a whole. An unusual life form is found in resurrection plants capable of extreme desiccation and rehydration (e.g. Borya, Cheilanthes) (Hopper et al. 1997, p. 141).

Lullfitz et al. (2017) argue that Noongar occupation of the south west over a long period of time had sustained ecological influence on flora of the region, including on and around granite outcrops, for example, the practice of firing the land. Some advantages of firing in relation to granite outcrops are voiced in the following quotes:

There are mangart (jam trees) near the Derdibin gnamma. Aboriginal people would have dug carefully around the mangart roots to gather bardì (witchetty grubs). The mangart had 73 uses, including being burnt in smoking ... When our ancestors moved on from a gnamma, they sometimes burned the surrounding area so that it would be green and regenerated when they came back. The green vegetation would attract animals for hunting (Noongar Elder Kevan Davis in Wheatbelt Natural Resource Management, n.d., p. 6-7).

During a trip by car between Perth and Albany, a now deceased Aboriginal man from the Great Southern region observed that the areas around some of the granite exposures we passed needed burning to ‘clean them up’. He said that traditionally it was permissible to burn around granites quite regularly because the exposed rocks provided a refuge for animals living nearby that fled to the vegetation free area during the burn. He also observed that there was always a piece of adjoining bushland that did not burn because of the topography of the granites, so homeless animals could easily re-establish themselves (Bindon, 1997, p. 175).

Refuge from fire, for birds in particular, is identified by Hopper et al. (1997): “Among woody perennials [of granite outcrops], bird pollination is frequent, and some outcrops harbour a high proportion of obligate seeder species due to the refuge from fire provided by bare rock barriers” (p. 141).

The practice of firing gnamma to enlarge them and the subsequent increase in water availability “undoubtedly had positive outcomes for edible aquatic plants such as Cycnogeton lineare (Juncaginaceae) and Myriophyllum petraeum (Haloragaceae), eaten by Esperance Nyungars ... Regular cleaning of gnammas according to protocol that ensures retention of seed store and microbes would also likely have assisted aquatic plant survival on granite outcrops” (Lullfitz et al., 2017, p. 212, citing Jenkin et al. 2011). Restrictions on when to harvest or disturb species, on not harming totem species, and gender, age and territorial restrictions could have also impacted on granite outcrop species (Lullfitz et al., 2017).
Lullfitz (2019) with others investigated *Macrozamia dyeri* populations along south east coastal regions of WA near Esperance. Zamia ‘nuts’ are known to have been used as food by Nyungar people. The locations of *Macrozamia dyeri* populations were recorded, and indicated “Nyungar influence on the contemporary distribution of the plant … [they] occur close to waterways in the west and to granite outcrops in the east of Esperance Nyungar country, which corresponds closely to differential pre-colonial pattern of Nyungar occupation and movement across country” (p. 71). Further, the “Abundance of *M. dyeri* populations was negatively correlated with distance to registered Nyungar sites” (p. 71). Lullfitz et al. suggest the results indicate that a mutualistic relationship with Nyungar people has influenced *M. dyeri* distribution. One significance of the results is that traditional landpractices associated with the plant could inform landpractices today.

Explorers, led by Aboriginal guides, certainly benefitted from growth at the base of granite outcrops, for example Forrest (1875), travelling in the mid-west, wrote:

> Left Mount Churchman in company with the nine natives, and travelled about North-North-West for ten miles to a small water-hole called Woodgine, thence in a northerly direction to a branch of Lake Moore, which we crossed without difficulty, and, following along its north shore for three miles, we bivouacked at a spring close to the lake called Cundierring, with splendid feed around the granite rocks (no page number, digitised diary).

5.2 Fauna

On traditional use of rocky outcrops: “Gnamma attracted animals and birds that we hunted and ate including *yonga* (kangaroo), *djurrang* (lizards), *djert* (birds) and *yerderap* (ducks)” (Noongar Elder Kevan Davis in Wheatbelt Natural Resource Management, n.d., p. 6). In December 1897 the Kalgoorlie Miner quoted Tickebutt (an Indigenous man known as Fred McGill), “Before the white men … the blacks obtained water at the different rocks … They got plenty of food, too, by watching at the rocks for kangaroo and emu, when they came to drink, and spearing them there” (Learning Federation, n.d., webpage). Austin (quoted in Bindon, 1997) observed:

> “In many places about the country, and particularly near some of the rocks, brushwood fences are found that serve, or have served, the purpose of trapping game. These fences are about two feet high, and simply made of broken-down shrubs and branches of trees, mainly mulga, and converge to an angle after extending for a long distance over the ground” … At the end of the fence or at the convergence of two of these, holes were dug into which fell any animals that followed the fences to a gap. In other cases nets were suspended to ensnare animals which traversed the fences to the narrowing funnel. Austin goes on to say, “Near the rocks I have seen them constructed in a zig-zag shape, with the self-acting trap at the apex of the angles furthest away from the rocks” (Bindon, 1997, p. 175)

> “The isolation of ancient granite outcrops and gnmmas within the landscape has contributed to the evolution of endemic species. There are at least 50 aquatic invertebrates endemic to gnmmas” (Wheatbelt Natural Resource Management, n.d., p. 18). The Ornate crevice-dragon is a WA granite outcrop endemic. “These lizards are heavily dependent on sheets of rock for cover. They have disappeared from most granite hills near settlements because people invariably remove rock slabs for building water catchments (historically) and for garden landscaping” (p. 18). The role of the Aboriginal intervention, the construction of lizard traps which provide rock cover and so potentially encourage sustained lizard populations, not particularly of the Ornate crevice-dragon, has been described above. As for flora, Aboriginal cultural restrictions on not harming totem species, and gender, age and territorial restrictions could have also impacted on animal species that frequented or lived permanently on or around granite outcrops (Lullfitz et al., 2017).
Invertebrates living in gnamma have been given recent attention. Timms (2013) examined 50 pit gnammas in the Wheatbelt (Noongar Country) and adjacent Goldfields, over 2010–2012 and found “82 taxa of invertebrates rich in insect variety but dominated numerically by a few crustaceans” (p. 55). Results also showed that “pans are more species rich than pits, and have many endemic species, mainly crustaceans, but also a few insects ... Fluctuating climates over millennia coupled with poor dispersal have promoted speciation among these crustaceans. By contrast, the more persistent pit gnammas support eurytopic species mostly easily dispersed” (p. 55). The creation/enlargement of pit gnamma by Aboriginal people over long periods of time could also have impacted on the invertebrate evolution, in the way that Lullfitz (2019) argues in regards to human intervention and flora evolution.

6 SONGLINES, CEREMONY, DREAMINGS

6.1 Songlines

Songlines or Dreaming Tracks are typically believed to have been created and followed by spirit ancestors, and have been followed through the generations, including for trading. “In a Songline, each location in a landscape has attached to it an instruction about the relevant song, dance, story, character or all of those. In those songs and stories is all the information about a particular thing that people needed to remember, as well as the rights and responsibilities attached to that information. It is the practical information needed for survival ... Depending on the nature of the information it is necessary to repeat it regularly in the form of ceremonies and rituals (meaning a repeated act) to ensure it is accurately remembered” (Sheperd, 2016, webpage).

Songlines necessarily link water sources, for survival, and “being well acquainted with the probabilities of the climate and knowing intimately all the water storages of their region, their [Aboriginal people’s] actions and movement to new water sources were always carefully thought out with all likely possibilities considered. When the group did decide to move, their course would often involve travelling between a series of granite domes, which then became not only resource bases, but also navigational markers” (Bindon, 1997, p. 174).

A Songline example from Noongar Elder Noel Nannup is that “If you start at the Stirling Ranges, then you go across from there to Wagin Narrogin, then back up towards Wave Rock, then back across through beyond near Merredin, then back across through to Lake Moore. That is your W ... Each star [which Noel pointed to] lines up with a prominent granite rock in the land which marks a turning point along the song line” (British Broadcasting Corporation, 2017, transcript of video). The Nyitting (Dreaming or Cold Time) trail between the Great Victoria Desert SA/WA to Augusta WA is a second example. In Noongar country it includes “Mulka’s Cave (north of Wave Rock), Wave Rock, Jilakin Rock, jitarne Rock, Dumbleyung Lake and Puntapin Rock are all connected by an ancient Dreaming trail [Songline] that reaches the coast at Augusta” (Wallace and Huston (eds.), 1996, p. 119).

Mulka’s Cave [granite] is the home of Mulkin-Jal-lak, a giant evil spirit man (Wallace and Huston (eds.), 1996). Wave Rock “is known to Nyoongar people as Gnardin-Daran-E-Noo” (ibid, p. 119). It is where the spirit woman launched herself into the sky, with spirit children in her hair, to become the Milky Way (Nannup in Morgan et al., 2008). Jilakin Rock “is the place where the salt water and freshwater peoples met and separated. It was also an important place for trade between the two groups of people” (Wallace and Huston, p. 119). “There is a very fine grove of jarrah trees growing at Jilakin Rock ... Jilakin Rock was in the days gone by a great meeting place for migratory native tribes who penetrated inland each winter, returning to the coast each summer when water became scarce. Probably the seeds were carried there accidentally....The blacks however account for it differently... The legend runs that two spirits meeting at the rock, married, and camping their struck their spears into the ground, where they sprouted and grew into two jarrah trees. .. the jarrah seed very heavily, flowering practically every year...” (West Australian, 18/02/1933, p. 119).
The stand of jarrah trees is at the base of the rock. They are the most isolated natural jarrah trees known, and are around 150 km (93 mi) east of the main jarrah belt, and they survive on water that runs off the rock and quarry soils at the base of the rock (Central Wheatbelt Visitor Centre site, n.d.).

Jitarning Rock “is a place where, through special ceremonies, Nyoongar people ensured that all animals would be healthy and fat for the next hunting season” (Wallace and Huston (eds), 1996). Dumbleyung Lake was once a permanent freshwater lake and is now a saltlake. It was “a significant source of food and water for the Wilman people of the region, attracting birdlife, wildlife, fish and yabbies” (Wuddi Aboriginal Cultural Tours, n.d., webpage). Puntapin Rock “is a natural water catcher that was used by the Noongar people ... The rock is the intersection of a number of dreaming tracks so is an important ceremonial place for the Noongar people. You can see on Puntapin, abundant examples of the gnammas” (Premier Mill Hotel, n.d., webpage). Songlines that link granite outcrops or domes are not restricted to south-west WA (Noongar Country). Both the examples above go further— the W Songline goes to a granite dome near Lake Moore (‘Mount Singleton?), in mid-west WA, and Mulka’s Rock etc form only a small part of the Songline between the Great Victorian Desert and Augusta.

Another Songline example comes from the Menang Noongar people in the granite-rich Albany region on the south coast:

According to Menang legends there were two Waugals who lived on the [granite] islands (Michaelmas and Breaksea Islands) in the sea at the entrance to the large Sound (King George’s Sound). These Waugals lived on eggs from birds. One Waugal was greedy and ate all of his eggs but was still hungry, so he went to the other island and ate all the other Waugal’s eggs. Enraged by this action the other Waugal fought the greedy one. The fighting Waugals rolled across the landscape creating many of its features and caused the Menang much distress. Sick of these Waugals fighting, the Menang decided to build a snake trap [rock shelter/cave] on top of Mt Me[/161vell [which is largely granite] to catch the Waugals. The snake trap did not work and the Waugals escaped and continued to fight. In order to stop the Waugals fighting, the Menang then threw a camp dog at the Waugals. One of the Waugals bit the dog in half. The head of the dog can today be seen as represented by
Dog Rock [granite], with its tail being seen as a large rock ... on Emily Street near Middleton Road. After the fight finished and the Waugals separated, they both went in two different directions creating Oyster Harbour, the King River and Kalgan River. In the middle of Oyster Harbour, the greedy Waugal vomited the eggs he ate which created Green Island [granite]. From here the Waugal went up the Kalgan River to Morrilup Pool where he curled up and died. The red ochre on the shores of Morrilup Pool today represents the Waugals blood.” (Goode et al., 2005, p. 161, Aboriginal informant Lynette Knapp).

The Songline or Dreaming track that links the places in the narrative is known as Kinjarling (The place of rain) (ibid). It “broadly takes in a line from the islands, North West to Mt Melville, to Oyster Harbor then splits and follows the King and Kalgan Rivers to their completion” (ibid, p. 185).

![Dog Rock, Albany. Photo by Pat Forster 27/07/2020](image)

### 6.2 Ceremony and ritual

Since all the members of any Aboriginal linguistic group claim to be a descendant of one or another of the ancestral beings, and since the people are living in the landscape created by these ancestors, it follows that every person is linked by their lineage to the landforms, to other living things in the same environment, and to the associated mythology. ... By re-enacting the activities of their ancestors during commemorative ceremonies, Aboriginal people re-affirm and reinforce their religious beliefs ... Numbers of granite domes were used as ceremonial areas by Aboriginal people (Bindon, 1997, p. 175).

Several granite outcrops are recorded as being sites of ceremony and ritual including Jitarning Rock (see above), Wave Rock (Palmer, 2016), Walga Rock and The Granites in the midwest (Webb, 2007). Some sites have stone arrangements associated with particular rituals, for example to do with initiation (Bindon, 1997). Some sites are secret knowledge so their meaning is not divulged to outsiders. Ceremonies open to all sometimes take the form of corroboree or dance (Palmer, 2016). One explanation for the granite domes being chosen as ceremonial sites, besides religious or sacred associations, is the availability of water at them, to support the gatherings of people.

Goode et al (2005) describe a ceremonial ground near Albany on the granite rich south coast:

According to the Menang legends, the area of Toolberup [Two Peoples Bay] is a sacred womens law ground, with the south point being the women’s birthing place. Men are not permitted here, nor are they permitted to watch the ceremonies that take place here. According to the legend two mythical men named Mulurark and Boychartakup went into this area to watch a womens ceremony. When they were caught by the women who were enraged by their actions, Mulurar k was turned into the noisy scrub bird and Boychartakup was turned into stone. The Menang say that you can now see the head of Boychartakup at South Point who is the guardian spirit of Toolberup. They say you can still here Mulurark bellowing in the scrub in the area and who is trying to wake up Boychartakup (Goode et al., 2005, p. 140, Aboriginal informant Lynette Knapp).

Niches in granite allow the storage of sacred objects for ceremonial purposes. A case in point is Spear Hill in the Pilbara. The landscape is one of granite boulders and inselbergs (Hopper et al., 1997). The hill was the subject of recent litigation:

The hill is accessed through a valley of rock shelters full of artworks and secret niches where Aboriginal people traditionally hid sacred objects. ... FMG [Fortescue Metals Group] last year gained Aboriginal heritage approval to build a railway through the area ... and while the East Guruma people did not oppose the mine or the railway, they wanted the railway to go around their sacred sites. They asked the Department of Planning, Lands and Heritage for more time to prove their significance before FMG’s heritage application was determined. ...
after court action, review and consultation]....The EPA [Environmental Protection Authority] has now recommended WA Environment Minister Stephen Dawson give environmental approval for the project, but with conditions including protection and monitoring of predicted impacts on places of recognised Aboriginal cultural heritage (Young, 2019, webpage).

Rituals associated with granite outcrops include the following which are in relation to Derdibin Rock, south-west WA: “When we arrive at a gnamma, we throw in some sand to let the water spirits know that we are peaceful. We believe that the spirits are everywhere: they’re in the trees; in everything that’s living” (Noongar Elder Kevan Davis in Wheatbelt Natural Resource Management, n.d., p. 5); “When a group of people first arrived at a gnamma only the eldest – the decision maker – would drink the water at first. This elder would ensure that the water was safe. The others would wait, and then take turns to drink one by one” (ibid); and “While women were washing at a gnamma they would lay their babies under nearby kwel [sheoaks]. The sound of the breeze through the kwel is the spirits of the Ancestors speaking, which gently lulled the babies to sleep” (ibid). So, rituals acknowledged the supernatural and, as well, were directed at safe living.

6.3 Dreaming narratives

Amongst the activities which ancestors first performed, and which modern Aboriginal groups often maintain, is the creative formative journey first taken by the ancestor figure during the establishment of the present landscape. These ancestral journeys began so long ago that they now possess the qualities of dreams. ... Thus, the activities of ancestral beings around granite domes which occurred during the tjukurrpa (Dreaming) are mirrored by the actions of the most recent Aboriginal groups (Bindon, 1997, p. 175).

Besides actions such as ceremony and dance, the Dreaming can also be conveyed by narrative, which most suits this review, and can encompass creation of the night sky as well as the landscape on earth.

Examples given in sections above include the creation of the granite domes in Noongar country, when the Charnock spirit woman stepped onto a big stone which toppled over and broke up and pieces spread and became the domes (see Section 2); and the creation of gnamma by the Wargal (spirit snake) (Section 3.1); and creation of the Milky Way when the Charnock women leapt of Wave Rock with spirit children in her hair (Section 6.1). When the spirit children fall back to earth as shooting stars, and land on earth, they become stones (Noongar Elder Noel Nannup, in Morgan et al., 2008), and the first place they landed is Hippos Yawn, at the base of Wave Rock (Goldsmith, 2014, citing a plaque in Victoria Gardens, Perth).

There is a suite of narratives which relate to the predominantly granite Stirling Ranges, Barren Ranges and Fitzgerald Ranges near the south coast WA. One concerns the:

the Kangaroo people of the Stirling Ranges and the Emu people of the Barren Ranges. The former had promised a girl as a husband to an Emu man. When the time came for her to leave, a party of Emu people assembled to accompany her. She was saddened by the thought of leaving her pet dog, which was in turn upset at her departure. As they left, in the middle of the day, the dog howled. The party turned around to see why the dog had howled and were all turned to rocks. The girl became the Stirling Ranges, now seen as the ‘Sleeping Lady’, the profile of the ranges viewed from the Chester Pass to Albany road, which resembles a supine woman (Palmer, 2016, p. 198).
Another features the Kangaroo people and Emu people. “They had a fight and the Emu people were badly injured. They escaped to the Fitzgerald Ranges, spilling their blood on the ground as they went. This blood is now manifest as a red rock outcropping across the area between the Stirling Ranges and the Fitzgerald Ranges” (Palmer, pp. 197-198).

A third narrative relates to two brothers who lived near Ongerup. They were Parrot Men. They had a competition to see who could fly the fastest. They ran so fast that they collided with Mt Trio in the Stirling Ranges, making a cave in the mountain, through which they passed to emerge on the other side. This caused many of their feathers to fly about, which formed the many wildflowers across the countryside (Palmer, 2016, p. 198).

A fourth is a narrative of:

a narcissistic Kangaroo Man who spent his time preening himself in his reflection in a pool. His wife, tired of his vanity and consequential failure to supply her needs, cooked herself and her baby some meat. He returned to the camp to discover this and beat her as a punishment. She crawled away, mortally injured, forming the Kalgan River. She died and her pet dog buried her. Her grave is now Green Island, while she is also the Sleeping Lady of the Stirling Ranges. Her family, much aggrieved at her treatment, killed the Kangaroo Man, who became Bluff Knoll. The Noongar name for the mountain is Meilya, which means ‘many eyes’ and is a reference to the fact that the face of the Bluff alters as the mist blows across it, but can be seen to represent the face of the warrior. Seen from afar, the mist covering the mountain is understood to be his hair blowing in the wind, showing that he is still alive. (Palmer, 2016, p. 198).

Other Dreaming narratives comes from the south coast near Albany. One relates to three granite peaks and a chain of freshwater lakes. The central elements are:

Mt Manypeaks (Yoolberup), the North Sister (Mooilyup), the South Sister (Twerturtup) and all the freshwater lakes (which represent mythological tears) within the vicinity of these features in the landscape. Back in the creation period there were two tribal sisters of the Menang who lived with their husbands people in the Stirling ranges. Their names were Mooilyup and Twerturtup. Mooilyup was running away from her husband the Devil. The Devil was pursuing the sisters who were heading to Yoolberup which was their mother (Mt Manypeaks). Just before the sisters got to Yoolberup the Devil caught the sisters and being enraged by their actions for running away turned them to stone. Today you can see the two sisters in the landscape. The south sister is Mooilyup and the north sister is Twerturtup and her dog. The tears that the sisters had cast has formed the lake systems in the area around Mt Manypeaks and the two sisters (Goode et al., 2005, p. 142, Aboriginal informant Lynette Knapp).

A Dreaming told by Scott (2016), and Hassel (n.d.) with some variations, and referred to by Palmer (2016) explains a feature of a granite boulder in Noongar country on the south coast:

I told Clancy of how Kayang [auntie] Hazel made us stop the car at the edge of the bitumen road, beside an over-cleared paddock. ... she crossed the wire fence and led us across the shifting soil to a rocky outcrop. She pointed, there: a series of neat circles in the rock that grew small, then larger again. ‘Yongar and Miak’, she said, and told the old story of Kangaroo and Moon. Kangaroo complains of inevitable death, and how his bones will turn grey and crack in the sun as the hill grows around them. And Moon? Moon gets very sick and wastes away, but doesn’t die: the moon always returns, and grows strong again. It is both a responsibility and a privilege to stand beside where that story is imprinted in stone, and hear its ancient utterance (Scott, p. 15).

In ‘The Not-So Barren Ranges’, Scott (2016) tells of his adventures on the south coast of WA in reuniting a creation story with its landscape of origin. The story is:
of an ancestral figure hunting with his brother’s dogs, moving from east of where we were ... Time after time the dogs run down game, kangaroo, wallaby, emu, quokka, but, by the time the man reaches them, the animal has been eaten and nothing remains. The man is displeased; he is hungry. They move back this way (we said), from north-west of where we were talking by the campfire. On high land by the ocean, our ancestor rests, observing the dogs until, sated, they fall asleep. He lights a fire around them. The dogs awake and, leaping through the flames, tumble down a slope into the sea (p. 4).

Another version says: “You go down that way today and you’ll see the man still standing there. And at the other place you’ll see the seals rolling down the hill into the water” (Scott, 2016, p. 3). “We did not know it then but in the morning we would see the granite boulders; the dogs tumbling toward the water and the man looking after them and calling as they, now become seals, swim along the coast and into the distance” (ibid, p. 5).

Hill (2013) refers to a saga recorded by Bates (1921, 1925). In brief, children breached totemic law which resulted in major flooding of the Perth area:

The two surviving ancestral women who were pregnant and their nephew are washed out to sea on a tree trunk ... and then blown back to the land to the south, from where they travelled north and north again, to Boyagin Rock, and eventually back to Kalamunda, leaving standing-stones which were considered as spirit baby-stones, and a spirit baby-cave (p. 346-347).

The location of the cave is uncertain. “The two women were recognized as two fat Balga [Xanthorrhoea preissii] near the raised hill at Minjelungin springs or Booroloyin” (Hill, p. 247). Hill points out that “traditional culture recognized the importance of intergenerational recounting of flood including tsunami floods. The identification of .. Boyagin Rock ... with sanctuary remains useful and important knowledge” (Hill, p. 251, citing Bennell and Thomas, 1981). He also proposes the saga is an example of the “supplanting of newer tradition over stable and strong ancient totemic tradition, possibly after major flooding in the southwest” (Hill, p. 347). Others have identified similar for other narratives, in particular when new custodians assume authority over a region - after disintegration of the culture of previous traditional owners due white settlement.

In an anthropological report on the ‘Boyay Gogomat’ or ‘owl stone’ near Susannah Brook, Red Hill, Mundaring near Perth, Macintyre and Dobson (2009), included a narrative told by a Noongar Elder about the mopoke and carpet snake (Wakaal):

The story, according to the informant, related to the custom of sharing meat, for the Wakaal and the mopoke were like brothers. They both hunted at night and would share their meat with one another. However, one night the mopoke was unsuccessful and did not catch anything, so he went to the carpet snake’s camp and saw him finishing off the last of the meat (dadja) which he had caught. The mopoke became very angry at the Wakaal for not sharing his food and attacked him with his club. They fought all night until daybreak. The mopoke became blinded by the sunlight and at this time the Wakaal escaped into the river and sank to the bottom creating a large pool. The mopoke flew onto a large tree overlooking the pool, waiting for the Wakaal to come out. However, the Wakaal never came out but made tributaries up and down the river to enable it to move around in search of meat (webpage).

Noongar informants said the myth was a recurring theme in southwestern Australia. The Waugal and the mopoke are both “associated with sacred winnatch areas which require the performance of certain ritual ceremonies ... to avoid harmful consequences to those passing by” (ibid). One such ritual is the strewing of rushes around owl stones in accordance with tradition.

In summary, Dreaming narratives have many functions. They can explain creation (of granite domes) or phenomena (waxing and waning of the moon) or be grounded in religion or belief (safe passing of owl stones). Others are mnemonics for remembering places (granite formations like Hippos Yawn), some guide behaviour (not to surround dogs with fire), and others give useful information (granite domes can be a places of sanctuary in times of flood).
7 ART AND ARTEFACTS

7.1 Rock art

Rock art is classified into two types: petroglyphs which are pecked or otherwise engraved into the rock surface, and pictograms or pictographs which are painted on to the surface. Pictograms (chiefly handstencils) are widespread throughout the southern half of Western Australia (Webb, 2007). Examples on granite in the south-west are found at Beringbooding Rock (Central Wheatbelt Visitor Centre site, n.d.) and Mulka’s Cave near Hyden. The Mulka’s Cave site:

features 452 motifs, an extremely high number for the region where most sites have fewer than 30 motifs. The artwork is dominated by 275 handstencils, with 40 sprayed areas, 23 handprints, 23 paintings, 3 drawings and a single object stencil produced with a wide range of colours. The high diversity of art attributes is unusual in a region where the rock art is dominated by red handstencils (Gunn, 2006, p. 19).

In the Dreaming, Mulka is an evil spirit man who chased the Charnock woman and ate spirit children which she was gathering in hair prior to launching off Wave Rock and becoming the Milky Way (Nannup in Morgan et al., 2008). Gunn reports two other narratives about Mulka: “The outcast Mulka, driven from the tribe because it was feared that his crossed eyes would bring a curse to those he looked upon, took refuge in the cave at the Humps” (Gunn, p. 21, citing Meeking, 1979). In the second:

Mulka was the illegitimate son of a woman who fell in love with a man to whom marriage was forbidden. As a result, Mulka was born with crossed eyes. Even though he grew up to be an outstandingly strong man … his crossed eyes prevented him from aiming a spear accurately and becoming a successful hunter. Out of frustration, Mulka turned to catching and eating human children, and he became the terror of the district. He lived in Mulka’s Cave where the impressions of his hands can still be seen much higher than those of an ordinary man… (Gunn, p. 21, citing the Department of Aboriginal Sites, 1989)

Few petroglyphs on granite seem to be reported for the south of WA. There are a small number on a granite outcrop overlooking Old Mutton Bird Road, east of Albany (Goode et al., 2005). A rock face “contains worked grooves, shards, a serpent figure, arranged stones and a carved arrow head marker” (p. 26). Another site in a bay on the west
side of Herald Point, Albany “consists of an anthropomorphic figure, a lizard and two dots on the vertical face of a granite outcrop” (Goode et al., 2005, p. 21)

The Granites in mid-west WA “is a major mythological and ceremonial site complex located a few kilometres northeast of Mount Magnet where grinding patches, petroglyphs and pictograms have been recorded” (Webb, 2007, p. 123). The presence of both art forms is significant because they link The Granites culturally to both the Pilbara, where there are mainly petroglyphs, and the Kimberley, where there are mainly pictograms. or perhaps to the Western Desert (ibid). Petroglyphs on the granite dome at Camel Soak, north of The Granites and near Cue, frame grinding patches. “The petroglyphs and patches are patinated to the same degree, suggesting that they were made contemporaneously. ... It is generally accepted that grinding flour was women’s work. ... Whereas, men are thought to have made most of the rock art in Australia ... Not all art was sacred or not to be viewed by women, however. ... At present, the juxtaposition of petroglyphs and grinding patches at Camel Soak is locally unique, making the site difficult to interpret” (p. 123).

![Petroglyph at The Granites, age unknown. photo by Pat Forster 01/06/19](image)

Also in the mid west of WA:

the inselberg known as Walganna or Walga Rock, located about 60 km east of Cue .... Situated adjacent to a temporary water hole, a shallow west-facing shelter runs for more than a hundred metres on the south-west side. This shelter developed along sheet joints; the highest and deepest part evolving through haloclasticism as well as thermoclastically. The rear wall of the rock shelter is decorated with paintings in red, yellow and white pigments (Bindon, 1997, p. 176).

“Over thousands of years, paintings representing snakes, goannas, spears, handprints and even a sailing ship were painted by visitors before they moved on. A report by the University of Western Australia indicated there were more than 988 motifs on a 100-metre-long panel” (Lewis, 2016, webpage). New paintings have been made over older paintings, possibly because the older motifs were no longer significant to the people making the new ones (Webb, 2007, citing Gunn et al., 1997).
There is extensive rock art on the Burrup Peninsula and Dampier Archipelago in the Pilbara (north-west WA):

Most of the art is on Neoarchean (2.7 billion years old) intrusive igneous rocks including granophyre, gabbro, dolerite and granite. Petroglyphs were produced by removing the outermost few millimetres of dark red-brown iron oxide to expose a pale-coloured 1-cm-thick weathered clay-rich rim above the dark grey-green, very hard fresh rock” (Donaldson, 2011, p. 35).

In the Dampier Archipelago (offshore from the Burrup) “there are a number of distinctive motifs; Decorative Infill figures, climbing men and the archaic Face” (McDonald and Clayton, 2016, p. 35-36).

Withnell (1901), writing from Roebourne area, in the Pilbara, gives an account of how petroglyphs are formed.

They have very many rock carvings; every hill that has suitably hard stone will have some kind of figure tattooed thereon. They do not choose the softer rocks, and mainly prefer the basalt and granite. The method adopted is to draw the outline with chalk or ochre and with a sharp hard stone hammer within the outline until the rock is fretted away about one-eighth of an inch deep... The carvings are mainly representative of men, kangaroos, rats, opossums, emus, turkeys, fishes, spears, shields, native weapons of all kinds, and many men and women in a variety of vulgar attitudes (p. 29).

“The Woodstock Abydos Protected Reserve along the Upper Yule River, inland Pilbara, represents a distinctive rock art style province, with petroglyphs engraved on granite domes. There are over 550 recorded sites in the Woodstock Abydos Reserve ... Several major occupation sites were recorded near freshwater sources, with multiple forms of cultural activity, including rock art production, stone tool manufacture, and seed grinding” (Brady et al. 2011, p.70). It contains a unique form of representation. “These figures have long flexible limbs ending in forked hands and feet,
protruding muzzle, usually one or more antenna-like head decorations, and frequently exaggerated genitalia” (McDonald and Clayton, 2016, p. 37).

There are several other major rock art sites in the Pilbara including Port Hedland, Cooya Pooya, the eastern Hamersley Gorges and Ophthalmia Ranges and Depuch Island (McDonald and Clayton, 2016). “They are generally associated with water holes and rock pools; some are linked to increase ceremonies” (McDonald and Clayton citing Mulvaney 2010). Painted and stencilled art as well as petroglyphs are represented. The “petroglyphs are outlined or fully pecked [within the figure], abraded, scratched, incised or pounded, and also vary significantly in size” (McDonald and Clayton, p. 38). There are also many rock art sites in the Western Desert and the Kimberley (McDonald and Clayton).

Pictograms, off King River Road near Wyndham, Kimberley, age unknown. Photo by Pat Forster 03/06/2010

7.2 Granite artefacts and artefacts at particular granite domes
Goode et al (2005) note a small site, 25 x 40 metres, located in a small bay on the northern end of Whalers Cove, Albany, south coast WA, that that was reported as a source of grindstone material by Aboriginal informant Lynette Knapp. “Ms Lynette Knapp stated that her father Alfred Knapp and her grandfather Johnny Knapp would regularly collect water washed granite stones to use as grindstones from this location” (p. 116).

Portable stones in which grinding is done, have been collected near Cue, mid-west WA. Of 42 that were recorded, “15 are dished [grooved]; two deeply. The remainder have flat grinding surfaces” (Webb, 2007, citing Gunn and Webb, 2002, 2003). The difference might be explained by whether they were used to wet mill grass seeds or dry grind hard seeds (Webb, 2007). Available evidence did not support a conclusion. Other items noted in field work at granite domes around Cue included stone artefacts (not described), a well that potentially was constructed by Aboriginal people, dense and less dense scatter near the granite domes in the area (taken to indicate Aboriginal camping sites), and the rock art described above (Webb, 2007).

Bindon (1997) reports an excavation at Walga Rock’s shelter wall, of six square metres to a depth of about 3 m:

Evidence of human use of the shelter was found throughout the whole of the excavation sequence, giving us indications of human activity in the vicinity for the last 10 000 years. Occupation was intermittent and more or less in the same temporal pattern as delineated by other authors ... Periods of sparse use begin the sequence, followed by a gradual increase in visitation that culminates in an intensive occupation over the last few thousand years. At around 4 000 years ago, small delicately flaked stone tools begin to appear here just as they do around this time in many other Australian archaeological sites (p. 176).

Bindon (1997) also reviews and reports excavations on islands (granite domes) off the south coast of WA (Cheetup and the Reserche Archpelago). Patterns of occupation by Aboriginal people are inferred. On Cheetup, early on (before 13 245 ± 315 bp), “a pit was dug in the shelter floor. It was lined with Xanthorrhoea leaf bases and woody parts and filled with fruits of Macrozamia reidlii ... This ... discovery confirms ethnohistoric descriptions of a food preparation technique ... Toxins in Macrozamia fruits must be removed by leaching or fermenting and cooking before the fruits are rendered edible” (p. 176, citing Smith, 1993).

8 NOTE
A Noongar tourism operator (Maitland Hill), at the Spring into Parks Astrotourism Workshop, September 2, 2019, held at the Department of Biodiversity, Conservation and Attractions, said the songline went to a hill named Ninghan which is near Lake Moore.

9 ACKNOWLEDGEMENTS

I acknowledge and pay respect to past and present Aboriginal Peoples who have shared their narratives and practices in relation to granite outcrops, and respect the right of others who have not done so. I thank The Mount Magnet Project Group for our art-quilt project which led to my inquiry into Aboriginal use of granite outcrops.

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Statement: The survival of Aboriginal people in drought in Western Australia depended on their knowledge and custodianship of water resources, which clearly were evident.

Text on the quilt
- holistic view of water, land, sky, nature, kinship group ownership and responsibility
- moved camp to optimise water use, knowledge transferred between generations
- creation Dreaming, songlines that link waterholes, star maps for songlines, ceremony ritual lore
  Dreaming that conveys a moral
- rivers, creeks, lakes, gnammas, soaks with wells, springs, flooded claypans, river waterhole, waterholding
  frogs, trees
- vessels, purification
- symbols, language
Abstract: This review takes a multifaceted look at traditional Aboriginal water management, and cultural beliefs and attitudes to water by Aboriginal peoples. References are drawn mainly from Noongar Country in the south-west of Western Australia, with practices in the drier regions of the State addressed to a lesser extent. The approach recognises that Aboriginal Peoples have an holistic view of water which encompasses Dreaming narratives about creation, custodianship of water sources, education by passing down knowledge through the generations, the role of nature in signalling the health or sickness of water, and various means for communicating locations of water. The Dreaming narratives mediate a respectful, even fearful, attitude to water, and careful management of it. This review complements others that address a single subject in depth, for example, types of water source. Truth telling is embraced by referencing the appropriation of water by settlers and explorers for their own use, and subsequent catastrophic effects for Aboriginal Peoples. The paper concludes with a review of implications for ongoing water management that recognises Aboriginal cultural values.

Keywords: Aboriginal water management, Dreaming narratives, Noongar culture.

Warning: Readers are respectfully advised that this review contains names of Aboriginal persons who are deceased.

1 INTRODUCTION

1.1 The review and motivation for it
This review is the result of an internet-based search on water-management by Aboriginal peoples. My initial purpose was to obtain information to build authenticity for two art projects. I sorted references as I read and pasted them under headings. I created a booklet with all the references and uploaded it onto my website. The interest in it, based on the number of downloads, surprised me. Then, I received an email from someone unknown to me, who said I should seek publication in a journal, so I decided to work on the quality of the review. A statement by Daniell and Daniell (2019) provided another imperative: that water history of the continent prior to colonisation needs to be acknowledged and celebrated so that it can be truly valued and allowed to inform the next waves of Australia’s water management reform journey. When finished, I checked word counts allowed in journals and realised the review is too long for that media, so decided to again self-publish on my website.

1.2 Limitations of the review
The review represents values of an outsider, that is a non-Aboriginal person, in regards to selection of what has been included. A second aspect is that my internet-based search was largely restricted to freely-accessible accounts, and did not include publications that required special access. I mention also that I have no formal qualifications in hydrology or any other aspect of water management, but do have doctoral and post-doctoral research experience.

The review doesn’t cover water management for a specific time-period. It certainly can’t be said to be limited to Aboriginal views about water before European settlement, because most references were written in the 20th and 21st centuries; and narratives evolve over time, in the oral tradition and by different speakers, and sometimes take in contemporary conditions (Maranda, 1972). However, I present the review as being grounded in traditional attitudes, beliefs and management practices of Aboriginal Peoples: I draw on accounts by Aboriginal Elders in research papers and Government reports, accounts from the diaries of early settlers and explorers, and statements relating to a Native title claim (Palmer, 2016). References from Aboriginal Art Gallery websites and exhibition catalogues are also included. Justification for these is that there is a current movement for handed-down knowledge to be expressed through art with accompanying verbal narrative - these references are clearly identified for the critical reader, as are other references from non-conventional sources.
1.3 Review organisation

The review starts with a section headed ‘Water management, an holistic view’ which addresses attitudes towards water, Dreaming narratives and beliefs about the creation of the landscape including water, and narratives about desirable behaviour towards water, as well as ceremony and ritual. Sections follow on ‘Fresh-water sources and made structures’, ‘Water treatment and degradation’, and the ‘Media’ used to communicate the location and nature of water sources. The review finishes with sections on ‘Appropriation of water sources by European explorers and settlers’ followed by ‘Implications for water management today’.

The sections include broad statements from the literature which are said to apply to Aboriginal Peoples across Australia. Illustrative examples from Western Australia (WA) are provided if available. More references were sourced for Noongar Country than for other regions. Noongar Country, in the south west, is approximately triangular with boundaries from Geraldton down the west coast of WA, and east along the south coast to Esperance: Esperance to Geraldton is the third side of the triangle. Noongar Country has fourteen language groups. Other major groupings referred to, each with multiple language groups, are peoples of the Eastern Goldfields, the mid-west (Murchison and Gascoyne regions), north-west (the Pilbara), north (the Kimberley), and the Central Deserts. The territories of all language groups in WA can be seen on the map by Tindale (1940) and a simpler version by the Australian Institute of Aboriginal and Torres Straight Islander Studies (1996), both of which are online.

To understand when the impact of European settlement first impacted on Aboriginal culture in Western Australia, the reader needs to know the first settlement was in Albany, King Georges Sound, on the south coast in 1826, followed by proclamation, in 1829, of the Swan River Colony which included Perth.

2 WATER MANAGEMENT: AN HOLISTIC VIEW

2.1 Attitude to Water

Aboriginal people value water as sacred and as necessary for survival (Moggridge, 2011). Water is:

protected by Lore, which provide a system of sustainable management ensuring healthy people. Aboriginal people’s connection with Country does not separate the individual features of the landscape whereas non-Aboriginal laws and traditions tend to separate water from the land and from the sky (Moggridge, p. 8, citing Millett, 1872).

“Traditional Aboriginal people view all natural features as part of a symbiotic whole and this belief permeates the Dreamtime stories” (McDonald et. al., 2005, p. 14).

2.2 Kinship-group ownership and responsibility

“Understand that Indigenous peoples of Australia ... have complex systems for ensuring their ancestors (creators) are kept happy. Part of this responsibility is being custodians of one’s land, sky and waters. This is through a strong kinship system that mandates a people’s responsibility to care for the land” (Australian Government, n.d., webpage). For Noongar people east of Perth (Palmer, 2016, quoting Millett, 1872): “Each tribe possesses a territory of its own, and each family of the tribe has its own especial tract of land within that territory, together with the springs of water thereupon” (p. 44).

McDonald et. al. (2005, citing Rose, 2004 and Keen, 2004) argue: “… exclusive control of water was a key factor in Aboriginal survival, and control of knowledge was, as it is today, a key form of defence. ‘Intellectual’ property rights to water knowledge constitute a significant domain of territorial integrity and thus sustainable habitation. However, exclusivity was traditionally balanced with an emphasis on flexibility and sharing” (p. 34). For example, in Noongar Country north of Perth: “GinGin took in people from Perth, York and Toodyay after the white man came. Went in the back of Regans Ford, Cataby. Roamed the swamps called the Namungarra, Mimingarra, Walingarra and Cuningara – all wet areas, the lakes, that’s where the blackfellas lived” (McDonald et al., 2005, p. 34, quote from registered heritage site entry, informant senior Noogar Elder).

Ownership and responsibility also depended on leaders/Elders knowing the likely locations of water in a changing weather environment and moving their people to optimise water usage. Movement between territories required agreements between the owner tribes. In the south west, Noongar tribes changed location seasonally, camping along the chain of lakes, swamps, estuaries and coast in warmer months and inland in cooler weather, always where fresh water was available (Grey, 1841b). For example:

during the winter period of Djilba, the local people sheltered in the woodlands and ranges of the Darling Escarpment ... Noongars were able to move to inland hunting areas once the rains had replenished water sources, and when water supplies in the dry areas of their territory were thought to be reliable (Water Corporation WA, n.d., p. 1).
In arid Australia:

Aboriginal people generally first used ephemeral water resources which disappear most rapidly. Claypans and other playa lakes that have great surface areas and little depth diminish quickly through evaporation. Following observation of storms in particular areas, people moved to the recently watered area. There they exploited whatever food resources they could while awaiting game attracted by new growth, and the flowers and fruits that follow a month or more after the storm passes. During their wait, they used the water in the claypans for their daily needs. As these resources diminished, the group would move back to more reliable water sources, perhaps wellshaded deep rock pools in narrow rocky valleys. Being well acquainted with the probabilities of the climate and knowing intimately all the water storages of their region, their actions and movement to new water sources were always carefully thought out with all likely possibilities considered. When the group did decide to move, their course would often involve travelling between a series of granite domes, which then became not only resource bases, but also navigational markers (Bindon, 1997, p. 174).

Gould (1991) discussed two alternative means whereby Ngatjarra [Ngaatjarra] Aborigines in the Western Desert [around Warburton, WA] survived when stressed by drought. The first strategy, “drought escape”, was adopted in response to long periods of absolute drought, and involved the abandonment of home areas and migration over long distances to join relatives already living in areas with an adequate water supply. ... The second strategy, “drought evasion”, involved the continuous occupancy of the home area and reliance on the more reliable water supplies such as soakage-wells (Bayly, 1999, p. 23-24).

In summary, tribal ownership brought with it responsibility of custodianship, and gave control over water which included sharing between tribes, to enable survival of all. Survival also depended on knowledge of water sources by season and by changing weather pattern, including extended drought.

2.3 Knowledge handed down from generation to generation

Aboriginal people’s ability to survive in and understand the Australian landscape is astounding and equates to: “Generations of Traditional Knowledge” (Moggridge, 2011, p. 5). Noongar Elder Noel Nannup (in Morgan et al., 2008) explains: “In the south, as in the north, people are connected to the waterways, most of them having been born in catchment areas. Within each catchment, they needed to know where the water came from because water is the giver of life and everything in that catchment is part of you” (pp. 103-104). Grey (1841a), provides an example from from when he was exploring north of Perth near Yanchep:

This morning we started at daybreak and breakfasted at Manbeebee, and immediately after breakfast resumed our route. I left the main party with two natives and travelled up a swampy valley running nearly in the same line as the chain of lakes we had followed in going. The natives insisted on it that these lakes were all one and the same water; and when, to prove to the contrary, I pointed to a hill running across the valley, they took me to a spot in it, called Yundelup, where there was a limestone cave, on entering which I saw, about ten feet below the level of the bottom of the valley, a stream of water running strong from south to north in a channel worn through the limestone’ (diary entry March 7, 1839, no page number).

Noel Nannup has detailed knowledge of the tributaries and rivers east of Perth that feed into the Swan River and his account links with nature and has spiritual elements:

... So the water comes this way then runs into what they call the Avon River, but in the old way it is called gugleyar, which means laughing water. This is because when it runs over the rocks it celebrates; it wants you to hear it, so you hear it laughing. It also wants you to see it, that’s why you see all the little bubbles come up; and by that time it is coming past Bullong Pool. Bullong is like the crane, you know, the long necked bird. That place is is just netween York and Northam. Sadly, some people interfered with the river. They tried to make it flow quicker by clearing it out and in the process buggered up Bullong Pool. A lot of sand flowed into it and the spirits are not happy. The water flows through York, Northam, Tooldjay.... (in Morgan et al., 2008, p. 105).

“In desert regions, the secret is the elders told them stories about the landscape that detailed every source of water to be found. Pointers include landscape such rock, where water seeps off when there are rains, into sand which protects the water from evaporation; and plant growth such as patches of grass” (British Broadcasting Corporation, 2008, video). Skatssoon (2006, quoting Indigenous hydrologist Moggridge) describes how, in arid regions, “Aboriginal people also used terrain, birdlife, vegetation and animals as markers for water ... For example, they followed dingos to rock pools and waterholes while ants led them to subterranean reservoirs ... They used the landscape ... For example, you’re in a dry area and all of a sudden there’s a large number of ghost gums, so you’d think there must be some groundwater” (webpage).

In addition, “Aboriginal people had extensive knowledge of the groundwater system” (Skatssoon 2006, quoting Moggridge). This is evident in Grey’s (1841a) reference above. Another example is that the Karajarri, south west
Kimberley coast, “recognise two main categories of water sources: ‘on top’ water and ‘bottom’ water. On top water is for drinking and digging up… This is groundwater dependant and replenished by rainfall and it included soaks, permanent waters, ecosystems surrounding springs, freshwater seeages on mudflats and various ephemeral surface waters. ‘Bottom’ water, described as big stream’, is under the ground and is not used for drinking. The knowledge of these artesian waters is credited to their forefathers’ stories” (McDonald et. al., 2005, p. 16, citing Yu, 1999).

“Gould (1969) pointed out that the sequence and location of water sources were memorized by Aborigines, and adults would instruct children as groups passed along a chain of waterholes. A knowledge of name sequence and the approximate location of water bodies would often extend beyond the regions that a person had actually visited” (Bayly, 1999, p. 17). Others also comment on the naming of water sources, for example, in south west WA: “all water bodies (lakes, soaks, rivers and creeks) had Nyungar names which indicated their significance to Indigenous people and that different places had different stories and rituals” (McDonald et. al., 2005, p. 15, citing Goode, 2004); and, in the Kimberley “water sites are named places with toponyms derived from Dreamtime beings and many of these places have mythological narratives associated with them” (McDonald et. al., pp. 15-16, citing Yu, 1999).

In summary, knowledge of surface and ground water -where it comes from and goes to, named locations, and what signals it’s presence when not visible – is/was passed down through the generations. Placenames arguably are important prompts for recalling other knowledge. The references indicate that water is respected as a giver of life, and also that it is viewed as living (laughing) and something not to be thoughtlessly and selfishly interfered with, including the flow.

2.4 Dreaming narratives

McDonald et. al. (2005, citing Rose, 2004), summarise the role of the Dreaming in relation to water:

Dreaming connotes both creation and connection (creation and life continuing to come forth - both original and ongoing creation); Dreamings created relationships that structure obligations of care, and that constitute webs of reciprocities within the created world; … rockholes, soaks, wells, rivers, claypans, water-holding trees, billabongs, springs and other localised water sources form part of the subsistence geography of country and almost invariable part of the sacred geography as well; the tracks and sites of Dreaming significance link surface, subsurface and aerial sources of fresh water (p. 26).

For Noongar people, the Spirit Snake, Waugal, is at the centre of Dreaming associated with water: “the Waugal is sacred and we don’t desecrate something that is sacred” (Kaartdijin Noongar-Noongar Knowledge, n.d. a, webpage). All Waugal narratives have sacred/spiritual meaning for Noongar people (Kaartdijin Noongar-Noongar Knowledge, n.d.). Dreaming narratives of the Waugal and other ancestral spirits are reviewed below. The different spellings of Waugal are those used in the various references.

2.4.1 Creation narratives referencing the Waugal

Noongar Elder Ralph Winmar explained:

The Nyitting or Dreaming means ‘cold,’ ‘cold time’ or ‘ancestral times.’ Noongar people know it as the Creation time. It is the time before time when spirits rose from the earth and descended from the sky to create the land forms and all living things. Nyitting stories laid down the lore for social and moral order and established cultural patterns and customs … Noongar creation stories can vary from region to region but they are part of the connection between all living things. At York you can see where the Warkarl (water snake) left a track when he came over the hill. The Warkarl made the rivers, swamps, lakes and waterholes. He came over the hills at York, and his tracks can still be seen. He came down the Avon river to the nanuk (neck) of the river at Guildford, where there is a bend. When he finished he went to a great underground cave in the river. He did not go on because the water further on was salty. The Warkarl is very important to us Noongar because we believe in the Dreaming (Kaartdijin Noongar-Noongar Knowledge, n.d. c, webpage).

There are 14 Noongar language or dialect groups and, while the Waugal Dreaming seems shared, it has many variations. The epic creation Dreaming ‘Moondang-ak Kaaradjiny: the Carers of Everything’, told by Noongar Elder Noel Nannup (Nannup, 2003), tells of spirits who: moved across the land during the nyetting (cold time), realised they were going to become real, and wanted one group (people, plants or animals) to become carers of everything. A huge spirit serpent, the Wogarl, used all its strength to partially lift the sky, so was the first to become real, and then created trails and hills, went underground, and rose again where there would be lakes.

Moondang-ak Kaaradjiny: the Carers of Everything (Nannup, 2003) can be seen as an overarching account, while the narrative above told by Ralph Winmar (Kaartdijin Noongar-Noongar Knowledge, n.d. c) relates to and explains particular landscape features. Named places appear in other Noongar accounts:
Mt Eliza [Kings Park, Perth] and its springs are said to have been formed by the Waugal in its struggle to get to the sea as it formed the Swan River. Lake Monger (Galup or Goobabblilup swamp) was formed as the Waugal diverted from its travels. It also formed a tunnel from here to Melville Water which is said to still exist. A mythological track is reported to run from the ocean to Mindarie to Wokalup Hill and onto Lake Joondalup related to which was an underground cave approximately 100m to the south of the lake (McDonald et al., 2005, p. 28).

Taking a broader view which subsumes the lakes mentioned above: “The continuous chain of lakes from Moore River to Mandurah were said to have been created in the Dreaming by the mythological Waugal or Rainbow Serpent” (Macintyre and Dobson, 2004, webpage). Other sites, include “the confluence of Bennett Brook and the Swan River (deep hole and underground cave home of Waugal and a winnaitch area); Burswood shell beds (scales of Waugal); Perth and Melville Waters (where Waugal rested); ... Currie Bay (nest of Waugal eggs); underwater cave at Minim Cove/Rocky Bay area (Waugal coiled around a pillar)” (McDonald et al., 2005, p. 45).

Of Waugal eggs, Armstrong (1886) reported: “There are certain large round stones, in different parts of the Colony, which they believe to be the eggs laid by the waugal. There was, lately, one such stone on the shore of Curries Bay ... On passing such stones, they are in the habit of making a bed for it...” (p. 789).

About the underwater cave, Noongar Elder Patrick Hume (1926-2015) said: 

One of the most significant of the Waugal sites on the Swan River occurs at Rocky Bay (‘Garrangup’), just to the northwest of Fremantle, where the Waugal is believed to have crawled into the limestone cliffs to sleep after causing a great flood that submerged all of the land between Rottnest Island (Wadjemup) and the coast (Walyalup). There is still a large limestone cave at Rocky Bay which has a central pillar supporting the roof. The Waugal is said to have curled around this central pillar while sleeping (City of Fremantle et al., 2016, p. 28).

Perth settler Moore (1842) made an early record of the flood narrative: ‘The natives have a tradition that Rottnest, Carnac, and Garden Island, once formed part of the mainland, and that the intervening ground was thickly covered with trees; which took fire in some unaccountable way, and burned with such intensity that the ground split asunder with a great noise, and the sea rushed in between, cutting off those islands from the mainland’ (p. 8). The flood narrative, like many Dreamings, has explanatory power and, like for many others, the underlying event—flooding of the land – is recognised scientifically to have occurred. Robertson et al. (2016), have formed a timeline of such narratives and events that have happened over millennia, from a nyetting (cold time) - the Permian ice ages, 350 million years ago, through to the Holocene flood, 7000 years ago. Their purpose was not to prove the truth of Dreaming narratives, but to highlight “the value of walking together, cross-culturally, seeking synergies of meaning” (p. 40). The effect though, is to bring cultural narratives into the realm of protoscience – mythical events that gain scientific traction.

The landforms and places referred to above all relate to areas on or near the Avon and Swan Rivers. Palmer (2016) describes seven Waugal tracks, in different parts of Noongar Country, each one identified with lagoons, inlets, lakes or rivers and other landforms. Plus, “a variety of individual Wagarl, not recorded as being a part of a longer narrative sequence, were recorded at such places as Margaret River, Canal Rocks, Hotham River and Bremer Bay” (p. 197). The creation of landforms in Menang Noonga Country (south coast) is explained with reference to two Waugal. Each lived on an off-shore island (Michaelmas and Breaksea), one ate all available food (eggs), moved over to the other, the Waugals fought over food and, still fighting, they “… rolled across the landscape creating many of the features we still see today...” (Museum of the Great Southern signage, 2009, Noongar informant Lynette Knapp).

For the Aboriginal community of Mandurah, 74 km south of Perth:

the creation story begins with a terrible drought. The bush, plants and meat became hard, tough and rank. Three Elders of the tribe made their way to the sea and began to pray to their creator for water. Their creator manifested itself in the form of a snake, which they called Waqyl who came out of the sea and gave birth to its young in the estuary which forms the unique shape of Mandurah today. Waqyl’s young stayed in the estuary until they grew bigger. Soon the young left their birthplace, travelling away uphill, forming the Murray, Harvey, and Serpentine rivers as they moved across the land Mandurah Community Museum, n.d., webpage, Aboriginal informant Elder Joe Walley).

Other insights about the importance of the Waugal Dreaming to Noongar people are offered by anthropologists Macintyre and Dobson (2004).

The Waugal was not only a creative totemic being but it was also a protector of the environment. According to Nyungar law, springs and gnamma holes could not be drained as it was believed that this would kill the guardian Waugal spirit and cause the water source to dry up permanently. The Waugal was said to be responsible for attracting the rain and keeping water holes and springs replenished. It was said to inhabit deep
dark pools and traditionally was seen to be both a destructive and creative force in that it could cause sickness as well as cure sickness. Likewise, underground springs that flowed into the sea were believed to be the essence of the Waugal, and in some cases these springs were viewed as ‘the children of the Waugal’ flowing from the river towards the sea. … It also explained through the mythological track of the Waugal how water moved throughout the Swan Coastal Plain as a system of underground streams interlinking wetlands to the rivers and ocean. This knowledge was an essential component of Aboriginal survival (webpage).

The examples above indicate that Dreaming narratives of Noongar people are cases in point for what holds generally across Australia: that “Aboriginal people’s understanding of their groundwater system permeates Dreamtime stories” (Moggridge in Skatssoon, 2006, webpage); and that a spirit snake like the Waugal, is commonly associated with water sources throughout most of Aboriginal Australia (McDonald et. al., 2005, citing Yu, 1999).

Another Western Australian example of a spirit snake is recorded for the Fitzroy River area in the Kimberley:

- the reproduction of water in this region is linked with rainbow serpents (kalpurtu) and the Fitzroy River was created by one such rainbow serpent or water snake. The story is regularly enacted in rituals associated with river country and the initiation of young men. Songs sung at such ceremonies recount the creation of the river and surrounding country with specific references to individual topographical features (McDonald et.al., 2005, p. 28, citing Touissant et. al. 2005).

2.4.2 Creation narratives referencing other spirit-creatures

The (freshwater) Waugal is not the only ancestral being that Noongar people associate with water. The ‘Shark, Crocodile (sea waugal) and Emu’ narrative tells of a crocodile “which moves across the sea and landscape. He loses part of his body in a fight with the Shark, creating the islands, sound and features on ... The ‘Crocodile’ interacts with other creatures including the Kangaroo and Bush Turkey as he travels along the coast north to Yanchep, where he is transformed into an Emu” (McDonald et. al., 2005, p. 52). Further:

The Walyalup (Fremantle) Dreaming story tells of Yondock, an ancestral crocodile that travelled down from the north, causing floods and disturbances, creating Wadjemup (Rottnest Island), Ngoooloomayap (Carnac Island), Derbal Nara (Cockburn Sound), and flooding the Derbal Yaragan (Swan River) with salt water. The Waagle or Rainbow Serpent, guardian of the fresh water, smells the salt and travels down Derbal Yaragan to see what’s happening. With advice from Woorriji (a lizard) in a cave in North Fremantle and strength gained from a freshwater spring at the East Street Jetty, the Waagle fights the crocodile, bites off his tail and places the tail across the mouth of the river to prevent salt water coming up stream. The tail is secured with hair from the armpits of the Waagle on the southern side of the river, and with toenails from the crocodile on the north side of the river (City of Fremantle et. al., 2016, p. 28).

Part of the crocodile’s tail remains and is visible from the Maritime Museum and the toenails are at the site of the Dingo Flour Mill (City of Fremantle et. al., 2016).

The above narrative with small variations is also reported by Goode and Harris (2018, citing Landscape Magazine 2003), as told by Noongar Trevor Walley. In it, the jagged crocodile’s tail is said to form a reef – ‘this reef once blocked the mouth of the Swan River at Fremantle, before it was removed to create Fremantle Harbour’ (p. 15). “Waugal then made crocodile walk back up north whilst his spirit remained as Garden Island. Hence, Garden Island is known as Meeandip Yondock (Yondock with tail missing)” (Goode and Harris, 2018, p. 15).

The taboo to the mixing of salt and fresh water, which features in the crocodile narrative, was relevant to a proposal to build a marina and other development at Mangles Bay, Rockingham, south of Perth. Noongar people and others were concerned about saltwater intrusion to the groundwater aquifer, and potential increased salination of Lake Richmond, with subsequent detrimental environmental impact including on rare thrombolites (Strategen Environmental Consultants, n.d.). The Noongar taboo is another example of cultural knowledge that is aligned with scientific understandings - salination of groundwater aquifers due to urban development and mining is a world-wide problem (Green et. al., 2016).

Macintyre and Dobson (2009) reported a narrative told by a Noongar Elder about the mopoke and carpet snake (Wakaal).

The story ... related to the custom of sharing meat, for the Wakaal and the owl were like brothers. They both hunted at night and would share their meat with one another. However, one night the mopoke was unsuccessful and did not catch anything, so he went to the carpet snake’s camp and saw him finishing off the last of the meat (dadja) which he had caught. The mopoke became very angry at the Wakaal for not sharing ... They fought all night until daybreak. The mopoke became blinded by the sunlight and at this time the Wakaal escaped into the river and sank to the bottom creating a large pool. The mopoke flew onto a large tree
overlooking the pool, waiting for the Wakaal to come out. However, the Wakaal never came out but made tributaries up and down the river to enable it to move around in search of meat (webpage).

The creation of waterways in the landscape, a cultural practice (sharing), and observations of nature (in the daytime mopokes perch in trees with eyes shut as if blinded), all point to the holistic world view of Aboriginal people where everything is linked.

The mythological creation of Lake Coogee in Perth recorded by McDonald et al. (1997) during a survey of the Jervoise Bay area [Cockburn, Perth] involves birds. According to an Aboriginal consultant for that survey, the myth concerns a sparrow and a hawk that flew to the round hole in the earth where the moon rested during the day. This hole is located in the vicinity of North Lake. The two birds stole fire from the moon in the form of a firestick. They flew along the limestone ridge near the ocean. The bush caught fire. The moon called his uncle, the ocean, to help. The ocean rose and extinguished the fire. Nyungars were drowned and the lakes in the area were formed, including Lake Coogee. This narrative like others above, refers to a great flood, so in part is like protoscience.

A Noongar narrative explaining the existence of a soak in the Kojonup district also involves birds, and encompasses the attitude of sharing (for the survival of all) as to opposed to greed (of some at the expense of others):

The country was gripped in drought and the only known water was salty. The health of the parched Aborigines, birds and animals deteriorated. An eagle-hawk, soaring about the sky and swooping to earth, observed that a fat and shiny crow had a wet beak, wet with fresh water. The eagle-hawk, seething with unparalleled fury, attacked the cunning crow. In so doing his claws split the rocks and the blood of the attacked crow was splattered over the surrounding rocks and earth. So, a freshwater soak is to be found in the Wakhinup area, hidden amid rocks and surrounded by rich, red loam (Goode et al., 2008, p. 14, citing Bignell, 1971)

In the Kimberley:

“there are beings called the Wondjina. They were rain spirits who were also involved with creation. They are said to come from the sky and paint pictures of themselves on cave walls. At one point in time it is said, the Wondjina were angry at how people were behaving in the world, so they caused a worldwide flood. This was caused by them opening their mouths, and when they did this rain would never cease. After the floods had killed all the humans, the Wondjina recreated everything. Obviously the Wondjina had to keep their mouths shut so that the world wouldn’t flood again. After doing this so long, their mouths disappeared, which is why in most images of them they have no mouths. The Wondjina ... are said to still exist in waterholes, ponds (Jones and Jones, n.d., webpage).

“Today, the Aboriginal tribes of the Worora, Ngarinyin and Wunumbul still revere the Wandjina and only certain individuals are given permission to paint them. It is said that the Wandjina could punish those who broke the law with floods, lightening and cyclones and the paintings of the Wandjina are believed to possess these powers, therefore according to the Aboriginals they are always to be approached and treated respectfully” (Holloway, 2013, webpage).

2.4.3 Gender-specific Dreaming narratives

Some narratives are gender specific - they are men’s or women’s business. For example, some Seven Sisters narratives, which tell of sisters being chased by a lecherous man, should only be told by women (Paddy Walker, Wongai Elder, Eastern Goldfields, quoted in Gormley, 2005). A second example is the Ngapa Jukurrpa narrative about the creation of water sources in Pintupi country in the Western Desert: “It is in this area that there are a large number of water soakages where Tingari Men stopped to obtain water during their epic journeys. ... The Tingari men and women travelled across great distances and laid down a body of ceremonies and other law which subsequently formed the basis of young men’s higher (post-initiation) education. The stories themselves are communicated only to initiated men” (Wroth, 2019a).

2.4.4 Narratives with a moral

“Underpinning Noongar lore is a set of values and a sense of what is kwoba (good) and warra winarch (bad spirit). Linked to this in the spirit world are a corresponding good ancestor, Motogon and an evil ancestor, Djinga. ... To keep social order and codes of morality, Noongar people maintain a set of values conveyed through stories handed down generation after generation with messages of right and wrong” (Kaartdijin Noongar-Noongar Knowledge, n.d. a, webpage). A sample of four narratives or warnings about water is provided below.

The Noongar legend of the two lost boys:

In a place called Mindarie Keys (near Quinns Rocks) [northern Perth] there was once a waterhole, and two boys were taken there from the desert by their tribesmen to be taught the law of their people. They were told that they could drink from the waterhole, that it was nice, fresh, rock pool water, but the two boys did not listen.
They could hear a loud rumbling sound coming from over the sand dunes, and when the men went away for food the two boys climbed over the dunes to see what the noise was. Over the dunes they saw a great expanse of water, more than they had ever seen before. They were getting drier and drier so they went into the sea. They tasted the water but spat it out because it was very salty. Then one told the other that it might be better further out, so they went further into the water. When they were out there the Wardandi, the Sea Rainbow Serpent, swallowed them up. He came in near the beach and circled round and round looking for a place where he could put them. Then he spat them over the countryside and they became two big Tuart trees (Heritage Council of Western Australia, 1998, p. 6). A lesson to listen and to drink fresh water only!

From the Wheelman Noongar people, south eastern Western Australia:

a tribe had been travelling a long distance, and at dusk had to camp ... several of the girls were given big pieces of bark, and told to get some water, and bring it back to the camp for the children. These girls, instead of coming straight back, began to play, they ran about, and scooping it up with their pieces of bark splashed themselves with the water, and tasted it. As they were away such a long time... the men ... went to look for them. Then they found them playing, they were so angry, that they took out their hunting spears and gave them each a prod in the carves of their legs. The girls ... ran as fast as they could, the men following them with their spears. As they ran, a big wind sprang up, and blew them into the sky. ... They stayed up there, because they were afraid ... and they are a lesson to other girls not to play on the way, for as they are so far apart from each other, they can never find a man, and therefore can never be married (Hassell, n.d., pp. 213-215).

Noongar “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 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, a bad spirit); wait until the water is clear then you can go and jump in (quop wirrin, a good spirit)” (Noongar Elder Dorothy Winmar in Harben et. el., 2004, p. 20).

In the Kimberley, Wonnaira, a giant serpent, “travelled inland from the sea, making the rivers as he went. The places he rested along the way became the big waterholes. Sturt Creek flows into a shallow lake, he camped at this lake, turning the water salty when he urinated” (Munroe, n.d., webpage, citing Isaacs, 2005). A warning not to pollute water as it will become salty and undrinkable.

In summary of the ‘Dreaming narratives’ section, many of the examples from Noongar Country and wider Western Australia feature spirit creatures, particularly the Waugal (a snake). The spirit-creature component is commensurate with the narratives having sacred meaning, and an important aspect of Aboriginal Peoples’ conception of water. The narratives function to: explain the creation of water sources, identify moral attitudes to water, and they mediate a respectful, sometimes fearful, attitude to water and that it is something to be shared. Landscape features mentioned are often in named places that can be visited today. Some narratives reference observable behaviour in nature. Taken together, the examples point to an holistic world view. Some describe events that are known scientifically to have occurred, specifically the nyetting or cold time, which can be construed as an ice age, and a great flood.

2.5 Songlines/Dreaming Trails

Many Dreaming narratives, including some described above, address the location of water. Thus, they serve as oral maps for Songlines/Dreaming trails, and are mnemonics for locating water. To elaborate, Songlines:

are paths across the land (or sometimes the sky) which mark the route followed by localised ‘creator-beings’ during the Dreaming. The paths of the Song-lines are recorded in traditional songs, stories, dance, and painting.

... A knowledgeable person is able to navigate across the land by repeating the words of the song, which describe the location of landmarks, waterholes, and other natural phenomena (Jones and Jones, n.d., webpage).

The Emu Dreaming Track (McDonald et. al., 2005) in Noongar Country north of Perth is associated with the Shark, Crocodile and Emu narrative (see ‘Creation narratives referencing other spirit-creatures’ above, first paragraph). Sites on the track, include Emu Cave, Pipindinny Swamp/Lake, Nowergup Lake, Kinsale and Rosslare Soak(s). “Various features in the landscape represent parts of the Crocodile’s/Emu’s body and its transformation” (p. 52); Pipindinny Lake “is where the Emu sat down and blood ran out to colour the lake” (p. 42).

McDonald et. al. (2005) also briefly refer to two Turtle Dreaming tracks and a Mythical Dog (Doorda/Dwert) track, all in Noongar Country. One turtle track links Lake Gnangara, north of Perth, “with other lakes and wetlands in the region, including a wetland on the corner of Sydney and Gnangara Roads” (p. 52). The other extends from “Muchea to Jarrahdale area” (p. 33). The Doorda/Dwert track reportedly links “Nyeerugu (near New Norcia) where there were apparently two water sources – one fresh and the other salt ... [with] Doorda Mya Cave in Boomerang Gorge, Yanchep, an ancestral dog site ... and other sites in the South West” (p. 52).
The trail from the Great Victoria Desert, SA/WA to Augusta, WA, is another in Noongar country. It includes “Mulka’s Cave (north of Wave Rock), Wave Rock, Jilakin Rock, jitarning Rock, Dumbleyung Lake and Puntapin Rock” (Wallace and Huston (Eds), 1996, p. 119). Mulkas Cave was the home of Mulkin-Jal-lak, a giant evil spirit man who chased spirit children (Wallace and Huston). Wave Rock is where a spirit woman launched herself into the sky, with spirit children in her hair, to become the Milky Way (Nannup in Morgan et. al., 2008). Jilakin Rock ‘is the place where the salt water and freshwater peoples met and separated and was an important place for trade (Wallace and Huston). “There is a very fine grove of jarrah trees growing at Jilakin Rock … The legend runs that two spirits meeting at the rock, married, and camping their struck their spears into the ground, where they sprouted and grew into two jarrah trees” (West Australian, 18/02/1933, p.5). The stand of jarrah trees are the most isolated natural jarrah trees known and they survive on water that runs off the rock and quarry soils at the base of the rock (Central Wheatbelt Visitor Centre site, n.d.). “Jilakin Rock was in the days gone by a great meeting place for migratory native tribes who penetrated inland each winter, returning to the coast each summer when water became scarce” (West Australian, 18/02/1933, p.5)

Jitarning Rock “is a place where, through special ceremonies, Nyoongar people ensured that all animals would be healthy and fat for the next hunting season” (Wallace and Huston (Eds), 1996). Dumbleyung Lake was once a permanent freshwater lake and is now a saltlake. It was “a significant source of food and water for the Wilman people of the region, attracting birdlife, wildlife, fish and yabbies” (Wuddi Aboriginal Cultural Tours, n.d., webpage). Puntapin Rock “is a natural water catcher that was used by the Noongar people ... The rock is the intersection of a number of dreaming tracks so is an important ceremonial place for the Noongar people” (Premier Mill Hotel, n.d., webpage).

The Seven Sisters Songline which starts at Roebourne on the Pilbara coast and finishes in South Australia, is widely documented, particularly for the section of the Songline which is now named the Canning Stock Route (Kirkman et. al., 2019; La Fontaine & Carty, 2011; Neale (Ed.), 2017). The Seven Sisters narrative tells of seven girls who were chased by a lecherous man, and eventually escaped by flying into the sky where they are now the Pleiades. Water sources that they visited along the stock route include:

- Wantili claypan, near Well 25 on the stock route, a large round jurna (soak) and lyinji (claypan). The sisters rested at Wantili before throwing seeds (Kirkman et. al., 2019).
- Kartarru, which is now Well 24 on the Canning Stockroute. “Good drinking water is reliably available, and minyarra (bush onion) grows in seasonal abundance. ... The sisters danced at Kartarru before flying to Nyplill” (near Well 34) (Kirkman et. al., 2019, no page number).
- Kunawaritji, a natural spring, was turned into a well (Well 33) at the turn of the 20th century. The Minyipuru (Seven Sisters) stopped there and transformed themselves into distinctive trees that remain in the area between Kunawaritji and Nyipil (Well 34) (Kirkman et. al., 2019).

The above are not the only Songlines in Western Australia. Others include a Seven Sisters Songline through the Eastern Goldfields into South Australia – but documentation of it is fragmented (e.g., Goldsmith, 214; Gormley, 2005; Muir, 2012; Neale (Ed.), 2017; O’Brien, 2009). Another four emanate from Broome in the Kimberley (Salisbury et. al., 2016) - one of them goes east through Uluru to the Pacific Ocean. The role of song and story as oral mapping of water sources and other landmarks in the arid environments of the Songlines cannot be overestimated and is expressed eloquently, in prose, by Shilton (2018). An Aboriginal man was talking with a white woman as their party crossed the desert: “Because of the stories, (his hands tell me), the people are firm on the ground. They command the air with their song, telling the stories of here – in the shape of the mountains, the run of the sand on the riverbed, a secret waterhole cut into the rock” (p. 55).
In summary, Songline mapping through song, story and dance necessarily linked waterholes, to mediate survival on Songline journeys. Water sources are referenced and sometimes flora that need and signal the presence of water (trees in two of the above examples) and fauna that are attracted to the water (such as birdlife). Repetition, and probably also the amazing narratives, such as the Seven Sisters adventures, assisted map memorisation.

2.6 Ceremony

Throughout Aboriginal Australia all water sources – rockholes, fresh water springs, soakages, rivers, underground water and billabongs – form a vital part of traditional knowledge and ritual life. ... Ceremonies keep alive the memory of both the creation and the location of these sites. Aboriginal people meet for ceremonies beside water holes and their birthplaces are generally near one. Special ceremonies are performed seasonally to ensure that rains come to regenerate the plants and to provide food for both animals and people (Wroth, 2019a, webpage).

Wongi Elder Josie Boyle (in Goldsmith, 2014) spoke about ceremony associated with the Seven Sisters songline in the Eastern Goldfields:

And then we have lots and lots of lakes that nobody goes to much today... sites relating to the seven sisters. Beautiful sites. ... There are about six that are out there still. ... Gindowee, and Niagra Falls [Dam], and Boorley Well, and another site out there, and there are six out there, ... and that’s where they had their ceremonies, so that’s why these people a long time ago came together, my people, the Wongi people and the Warburton people, they all came together ... Grungada was that big thing that they were all meant to do it, and it was like a big dance, wasn’t it ... It was also for singing ... (p. 516).

2.7 Ritual

The Noongar ritual of throwing sand into water is well documented and still practised:

It appears to be common Noongar practice to perform a short ritual as acknowledgment of the spirits of the country. This normally involves taking a small quantity of sand from the edge of a creek, pool or lake in one’s hand, and throwing it into the water. For example, [Noongar] Joe Northover stated that it was important to go down to the water’s edge and throw a handful of sand into the water to let the spirits know that you were visiting and who you were. This should be done when a stranger first came into an area of Noongar country, and visits to other places in the area could then be undertaken in the knowledge that the spirits of the country would know and recognise you. This would also ensure a good night’s sleep and one’s general safety. Joe called the ritual of throwing sand into the water dugabarnin. He threw sand into the water, and called out to the spirit of the place in the Noongar language, in order to let the spirit know who we were and what we were doing on this trip around his country. This ritual was observed on a number of occasions during the research reported here (Palmer, 2016, p. 120)

Nannup (in Morgan, 2008) described another ritual:

in 1987, mum and I and some other members of our family went back to her country, to Millstream [in the Pilbara]. Mum said she had to go out to this pool... A great serpent lived there and she knew the right protocol that she had to do when she returned there. She had to get the water in her hands, then put it in her mouth and spray it out. ‘I am a child from this country’, she told us., that’s why I have to do that. She said that we had
3 FRESH WATER SOURCES AND MADE STRUCTURES

In Noongar country, south-west WA, water is reasonably plentiful compared to availability in central and northern regions of WA. In summer, the Noongar of Beeliar (Swan River) people “would locate near the rivers, and alongside the swamps adjoining Bull Creek. Alfred Cove [on the Swan River] and North Lake. ... There are also traditional wells behind the limestone cliffs on both sides of Blackwall Reach. ... In maggaro (the midwinter season) ... the Beeliar split up into small parties to work the foothill country and the lands immediately behind the Darling Scarp” (Cooper and McDonald, 1989, pp. 3-4) – a territory of tributaries and rivers. A similar pattern of movement is recorded for Noongar Peoples along the south coast (Goode et. al., 2013). Granite outcrops with gnammas abound on the south coast and east of Perth, and were sources of water (Goode et. al., 2013; Wheatbelt Natural Resource Management, n.d.). Goode et al have identified soaks and on the south coast, and early explorer Roe (1852) came across numerous soakage wells on that coast and east of Perth.

In desert regions of Australia, “specific sources of water utilized by indigenous people included; flooded gnammas (rock-holes), soakage-wells in permeable sediments, clay dams, flooded claypans, riverine waterholes, mound springs, rain-water accumulated in tree hollows (especially in Allocasuarina decaisneana), water from excavated tree roots (especially from mallee eucalypts), dew, and water from the body of the water-holding frog (Cyclorana platycephala)” (Bayly, 1999, p. 17). Macfarlane and McConnell (2017) identify many of the same sources as Bayly and distinguish ‘mound springs’ (natural pressure waters), as arising from an artesian basin, from ‘springs’, as arising from shallow groundwater and/or a subartesian basin. Except for dew, the listed desert water-sources and use of them are described below, with references to non-arid regions included. Dew is omitted as I have not found references from WA about its collection and use.

3.1 Rock holes/gnammas

“Gnammas are rock-holes commonly found in outcrops of hard rock, particularly granite’ (Bayly, 1999, p. 18). The holes or cavities initially form naturally. A depression in the rock starts through “moisture attack” (Bourne and Twidale, 2002, p. 87) and “sun exposure causing flaking, breakdown of crystalline irregularities, lichen attachment, attack of acid groundwater on bedrock” (Wheatbelt Natural Resource Management WNRM, n.d., p. 15); the rock breaks up, then the debris is evacuated - the broken rocks “get taken away by wind, get dissolved in solution, or are removed by people” (WNRM, p. 15).

Some gnamma have been enlarged through human or animal intervention: “The people used to heat the rock up and keep pounding it until it got deep enough so that they could have a water hole” (Noongar Elder Kevan Davis in Wheatbelt Natural Resource Management, n.d., p. 8). Also: “It is thought (e.g. Jutson) that both animals and Aborigines played a significant role in the enlargement of some gnammas by scratching debris and weakened rock from the bottom and sides while tapping the last vestiges of water” (Bayly, 1999, p. 20).

Gnammas are catchments for rain (Macfarlane and McConnell, 2017) and are classified into two basic forms: pan and pit. Pan gnammas are diverse in shape, shallow, flat-floored and seasonally fill with water (Timms, 2013). They “develop in laminated granite which allows more lateral rather then vertical moisture attack” while pit gnammas “form in massive isotropic rock” (Bourne and Twidale, 2002, p. 88), that is rock with uniformity in all directions. Pits are subcircular, have a depth to diameter ratio exceeding 0.2, and contain water for longer periods (Timms, 2013, p. 7, paraphrased).

Timms investigated gnamma in the Wheatbelt in Noongar Country and in the Eastern Goldfields, WA. Most pit gnammas had hemispherical to parabolic pit shapes. Some were cylindrical, that is had vertical sides. Some were on major vertical joints, and were “elongated along the joint, often narrowing at each end to give an overall ‘canoe’ shape” (Timms, 2013, p. 9). Others were formed on a major joint between two rock blocks so were like a trough. Two had an underground shelf and one was flask shaped. Many rims had minor joints and laminations.

An underground shelf can develop where “pits have penetrated through the base of a slab or sheet structure - runoff entering the pit flows through the base, a swirling action develops and a cylindrical hollow forms” (Bourne and Twidale, 2002, pp. 87-88). There is a large example at Beswick Rock, near Corrigin, in Wheatbelt Noongar Country, “some 6 m long and 3 m wide and at least 2 m deep” (ibid, p. 88). Other pit types not found by Timms (2013) are armchair hollows which are found on steep slopes, have “open downslope sides” (Bourne and Twidale, 2002, p. 87), a steep upslope side, and so are shaped to suit the name, and pipe gnammas which are narrow, deep pits.
Fiedler and Hopper (2016) identify that gnammas store and allow the exchange of surface and shallow subsurface water, and are landscape hydrologic connections, that is water movement connections such as from a granite outcrop to a soak. Consequently, they support humans, flora and fauna and the cycling of elements and compounds (ibid). Lullfitz et al (2017) suggest that deliberate enhancement of gnammas by Noongar people, including enlargement and cleaning, while primarily intended to increase water supply for human consumption, may have been a factor in modifying botanical patterns in the south west WA – including through the transport of seed to where there was gnamma water. The south west is a global biodiversity hotspot. A search (14/01/2020) on ‘gnamma’ in the Aboriginal Heritage Inquiry System WA yielded 27 registered sites, with greatest density in the southwest, and some scattered through desert areas.
3.2 Soaks and wells

Soaks are “water that seeps into hollows in freely permeable sediments” (Bayly, 1999, p. 20). They are shallow accumulations of groundwater (MacFarlane and McConnell, 2017). Waugal soak, close to Quaranup Rd near Albany, south coast WA, is an example. It is located in a stand of Banksias and Melaleuca (tea trees), and has a probable radius of 20 m (Goode et al., 2013). It was a traditional water source, location of an Aboriginal campsite, and home to the local diamond python referred to as the Waugal (ibid, Aboriginal informant). No well is reported.

Diary entries recorded in 1836 by explorer Roe (Hercock (Ed.), 2014), when exploring east of Perth, describe soakage wells and the settings and care of the wells:

Soil improved soon afterwards... came to grassy undulating land .. half a mile from of hill... At 2.35 halted at 2 small wells near the south side of the rock, whereby deepening out, we soon obtained abundance of water for our purposes. Grass good & land lightly wooded. Soil consisting of the decomposition of the granite rock – light but good. Wells were covered to keep them free from fouling by animals. This involved blocking the well with dead branches and uprooted trees. When the wells fell into disrepair, people would bail the well, using the coolamon to throw slush against the wall. This would set like a cement wash and help to hold loose sand, preventing it from falling into the water (p. 265).

Some wells access water from sub-artesian basins as well as, or instead of groundwater (Macfarlane and McConnell, 2017). Bayly (1999, citing Gould, 1970) describes a well at Pulykara in the centre of Gibson Desert that potentially fits this description: “This well, which was one of the most dependable sources of water in the region, had been dug down to a depth of about 4.5 metres to reach the water table lying beneath the superficially dry bed of a lake” (p. 21). Further, in the western Gibson Desert, Ngarinarri well “sustained the aborigines, Warri and Yatungka, the socalled “last of the nomads”, during a prolonged drought in the 1970’s (Peasley 1983). This well, which was dug through a claypan, was 3.5 metres deep” (p. 21).

A search (14/01/2020) on ‘soak’ on the Aboriginal Heritage Inquiry System WA yielded 80 registered sites, many more than for gnamma. However, while soaks might have been key water sources in some parts of WA, in the area defined by the Gnangara Mound (Noongar Country, bounded by the Swan River in the south, Moore River and GinGin Brook in the north) their use, as implied by archaeological finds, rates low. “Archaeological sites are likely to be located within 350m of a potential water source, including (in order of decreasing frequency) swamps, creeks, rivers, lakes, surface water, springs and soaks” (McDonald et. al., 2005, p. 37, citing Strawbridge, 1988).

3.3 Mound Springs

Mound springs are “systems fed by carbonated water under hydrostatic pressure” (Bayly, 1999, p. 22). The water comes from deep underground, through natural fractures in rock, and is often heated according to the depth at which it lies underground (Macfarlane and McConnell, 2017). “A typical mound consists of a central pool of water, an outer rim of reeds and vegetation, an outflow channel and wetland” (Macfarlane and McConnell, p. 46). Bayly warns that the word ‘spring’ seems often to be misapplied to soakage-wells. An example is that Dragon Tree Soak In the Great Sandy Desert is also called Munro Springs (Graham, 2001). Graham (2001) also provides examples of actual mound springs: there are some “within the Mandora Marsh area” (Graham, 2001, p. 326) which is at the western edge of the Great Sandy Desert, WA, close to Eighty Mile Beach.
3.4 Springs

In the absence of evidence of the water being carbonated water under pressure, the following references are taken to refer to springs, which Macfarlane and McConnell (2017) describe as being fed by groundwater or water from sub-artesian basins. About Perth, “there were freshwater springs on this site …. That was one of the reasons it was very important to Noongar people as a campsite” (Wynne, 2014, webpage). McDonald et. al. (2005) list some north of the Swan, including:

- “Minim Cove: ... Site of a major archaeological dig returning dates of c.10,000BP. Site associated with the Swan River and freshwater springs in area” (p. 46).
- “Jolimont Swamp (Mabel Talbot Reserve): Hunting place, camp, water source. A large turtle, mudfish and gilgie hunting area with permanent springs …” (p. 47).
- “King’s Park Women’s Site: ... Limestone at foot of Mt Eliza next to the spring where the Waugal entered the hill …” (p. 48).
- “Matilda Bay: Ceremonial site, camp, water source. A winter meeting site and fish increase site. ... Springs and pools located here also” (p. 48).

The descriptions indicate Perth ‘springs’ were associated with camping, hunting, ceremony and Waugal Dreaming.

Goode et. al. (2005) identify several springs in their survey of heritage sites of the Albany local government region (south coast), including “a permanent spring upon the southern embankment of King River” (p. 72). An Aboriginal informant said “Aborigines from other regions would regularly camp here while seeking local Aborigines permission to enter Oyster Harbour and Albany to fish and collect resources. A runner would be sent to Mt Willyung, where signals were seen (presumably smoke), before people could then continue their approach” (p. 73).

Roe in Hercoc (Ed.) (2014), exploring east of Perth in 1836, recorded in his diary: “came to a patch of excellent grass...between two water courses ... In the furthest, which drained in a green grassy hollow 100 yards wide, was a large deep native well 10 feet in diameter and containing a depth 4 feet water ... Here we pitched our camp ... This well is a great resort of the natives, whose marks are visible in considerable number all round... The well is a spring ...” (pp. 262-263).

A search on ‘Registered heritage sites, spring’ on the Aboriginal Heritage Inquiry System WA (01/02/2020) yielded 223 results.

3.5 Flooded claypans

A flooded claypan is “water lying in a depression in soft sediments with low permeability” (Bayly, 1999, p. 20). “The top soil of a claypan is removed by alluvial or aeolian processes, exposing the hard clay underneath. Upon this surface, shallow water may remain following rain” (Nowicki et. al., 2009, p. 5, citing Giles 1889). “Claypans are generally highly turbid” (Bayly, p. 21). “They are highly valued when they hold water because they support flora and fauna” (Nowicki et. al., 2009, citing Lowe and Pike 1990). “In the Great Sandy Desert, claypans were favoured camping places when they held water because they attracted game” (Bayly citing Lowe and Pike, 1990).

Explorer John Forrest’s party, when crossing the Little Sandy Desert, with the aboriginal guide Windich, relied on flooded claypans for water, in addition to springs and rock holes:

Steering East-North-East over spinifex red sand-hills for nine miles, we came to a valley and followed down a gully running North-North-East for two miles, when it lost itself on the flat, which was wooded and grassy. About a mile farther on we found a clay-pan with water, and camped, with excellent feed. The country is very dry, and I should think there has not been any rain for several months (Forrest, 1875, digital version, no page number).

A search on ‘Registered heritage sites, claypan’ on the Aboriginal Heritage Inquiry System WA (01/01/2020) yielded 75 results. Nine of the claypans have wells.
3.6 Riverine waterholes

Bayly (1999) defines riverine waterholes as: “water in holes scoured out of riverbeds by water movement” (p. 21). The holes are scoured out during floods, and the water may evaporate leaving the hole dry but some holes have permanent water (ibid). Like other water sources, explorers with Aboriginal guides utilised the waterholes, for example, when Roe was exploring the southeast coast of WA, he recorded:

The river here had a great and rapid fall among sheets and blocks of fine grey granite, which composed its entire bed and banks, with exception of occasional accumulations of a coarse quartzose pebbly sand, which had been carried down by freshes, and now lay in heaps 3 or 4 feet above the ordinary channel. The water in some of the holes in the rocks from 2 to 12 feet in diameter, was found to be perfectly fresh and good; whilst in others almost in contact with them it was far too brackish for use. The pools and holes were not full, and thin layers of salt, encrusted on the rocks, showed the gradual process of evaporation as the river had ceased to run (Roe, 1852, diary entry Dec 19, 1848).

A search (01/02/2020) on ‘Registered heritage sites, waterhole’ on the Aboriginal Heritage Inquiry System WA yielded eight results, and one result on ‘water hole’ - Gilah Waterhole, Sturt Creek, Kimberley. Based on their map positions, only some seem to be on rivers or creeks, e.g. Newman Waterhole on Homestead Creek, East Pilbara.

So altogether, the searches on the Aboriginal Heritage Inquiry System WA yielded 27 registered sites for gnamma, 80 for soak. 223 for spring, 75 for claypan, and nine for waterhole or water hole. The figures may indicate nothing more than which types of water source have been registered most frequently, and not which were relied on most – a subject for further inquiry. Another issue is searches on data base only identify places with the search word in place name (xyz soak etc) and not if the word is in the place description only.

3.7 Water from trees

Bayly (1999) describes extraction of water from tree trunk hollows by Aboriginal people, and from tree roots. Examples from Western Australia, for tree trunks, include the following. “They obtain water from a protuberance, or belly, on the paperbark tree (umebuk). They cut it with a tomahawk (cadjo) about an inch or so through the wood, the water
runs out clear and cool and somewhat acid. I have obtained several gallons from a large protuberance. It stakes thirst and acts as an aperient in a mild form” (Bates in Thieberger, 2017, Murray District (Noongar country), webpage).

Kappee ngogatung, getting water from the trees: The moodurt [paperbark tree], held water, and had plenty to give. "They cut a small hole in the wanda, through which the water gushed out. They put their mouths in the opening and drank, and then covered up the hole with a piece of bark which they hammered in with the kajjoo” (Bates in Thieberger, 2017, webpage, informant Woolberr of Gingin (Noongar Country)).

In 1857 Salvado described:

a species of eucalypt of which the wood is white, and extremely hard, but particularly subject to white ants’ ... The hollow parts of these trees often retain supplies of rainwater from the winter months till summer; and the native make it squirt out by boring a hole through one of the knots of the trunk, and quenching their thirst as at a clear fountain, afterwards blocking up the hole to preserve the water for later on. I have often drunk this way, and found the water fresh but not very palatable (Macintyre and Dobson, 2014, webpage citing Storman, 1977).

In the mid west of WA, the Yamaji people knew how to find water when it was in short supply: “This included taking water from trees such as the desert kurrajong, which holds up to a litre of water in its roots. Aboriginal people would look for clues to find water beneath the Earth’s surface, such as observing kangaroos scratching claypans” (Northern Agricultural Catchments Council, n. d., p. 34).

3.8 Water from frogs

"Water resources other than surface water, such as those from tree trunks and roots, dew and frogs, were very important to certain tribes such as the Ngalea [WA] ... and to people in transit” (Bayly, 1999, p. 23, citing Tindale, 1974 and Cleland, 1966). In summary (Bayly, 1990), the waterholding frog (Cyclorana platycephala) has the ability to take up a large amount of water (stored in the bladder) before burrowing beneath the surface of a claypan where they may aestivate for more than a year. Desert people appreciate the significance of some indistinct marks on the surface and cut into the rockhard clay with a hatchet to recover one of these frogs at a depth of about 30 centimetres. It was a common practice for Aborigines to squeeze the body water out of this frog and drink it. Aborigines could also detect the hidden chambers of aestivating Cyclorana platycephala by tapping on the hard surface with the butt of a spear. A further method, useful after a long period of drought, was to stamp on the ground and listen for the faint croaking of the frogs.

3.9 Tunnels

Moggridge (in Skatssoon, 2006) described how, in arid regions, groundwater was accessed through natural springs or people used to dig tunnels to access it. Sometimes they’d dig till they found the water and then they’d build a system so they could access the water. Sometimes they’d go fairly deep and people would slither down there and get their water.

Roe (1852) provides what could be an example of a tunnel, or a deep well, near the south east coast, WA . We: moved away to where Bob remembered to have drunk fresh water .... in one mile we reached it, and were offered another proof of the unerring memory and instinctive sagacity of the aboriginal native in thus being able in so intricate a part of the country....to walk direct to a small water-hole, entirely concealed from view amongst tufts of grass. ... plunging into the midst of these, our sable friend remained at least two minutes under ground, and then re-appeared with a distended stomach, and the welcome intelligence that plenty of good water existed 6 feet below the surface (diary entry 27/12/1848).

McDonald et. al. (2005) refers to a tunnel believed to have been made by the Waugal, from Lake Monger in Perth to Melville Waters on the Swan River.

3.10 Fish traps

Stone fish traps in the form of tidal weirs were used to manage tidal-river and estuarine waters, for the purpose of fishing – fish entered on an incoming tide and were prevented from escaping on the outgoing tide (Gibbs, 2006). Oral history recordings describe use of two in Perth, one near Point Walter on the Swan River, informant Whadjuk Elder Noel Morich (Parks and Wildlife Service, WA, n.d.). Another at the mouth of Bull Creek on the Canning River, informant Noongar Elder Marie Taylor:

When we look at the food that was caught from the Djalgarro (Bull Creek), it was great for fishing for mullet. And when the mullet was running, it would be the dolphins, kwilena, that would push the mullet down the river. And Noongars knew when they saw the dolphin kwilena running and swimming that in front of it would be mullet. And this would be where they would come and they would make nets [brush, not knotted nets], and
they would also make stone fishing traps. So that when the tide was high, the fish would be trapped, and when the tide went out there would be fish there which they could collect, and usually it was the mothers and the children that would go and collect the fish (Parks and Wildlife Service, 2017).

There is a well preserved stone fish trap on the shore of Oyster Harbour near Albany, south coast WA: “This site consists of a fishtrap and artefacts ... It contains a series of stone structures extending 1000m x 50m out from the beach in the intertidal zone” (Goode et al., 2005, p. 25). The workings of the trap are explained in detail by (Dix and Meagher, 1976). Goode et al also identify others in the Albany local government region: Marbellup Fish Traps, which “… measures 500m long x 80m wide. It consists of a set of stone alignments on the foreshore mudflats at the SE end of Wilson Inlet” (p. 20); Limekins Point fishtrap, Princess Royal Harbour, which “ ... contains a semicircular structure of 200+ granite stones extending out from the beach on mudflats adjacent to a low headland. It measures 45m long and 30m wide” (p. 21); and another “… in the river bed at Upper Kalgan 300 – 700m below the bridge near old Douglas homestead” (p. 25). There is another at Broke Inlet, at the mouth of the Shannon Inlet, west of Albany (Dix and Meagher, 1976) but, further, in relation to King George Sound, Albany, King (1827) wrote:

The mouths of all the creeks and inlets were planted with weirs, which the natives had constructed for the purpose of catching fish. Mr Roe, on his excursion round the harbour, counted eleven of these weirs on the flats and shoals between the two rivers, one of which was a hundred yards long, and projected forty yards, in a crescent shape, towards the sea; they were formed by stones placed so close to each other as to prevent the escape, as the tide ebbed, of such fish as had passed over at high water (Dix and Meagher, 1976 quoting King, 1827).

The Kalgan Tidal River trap was recorded early on by the French navigator D'Urville in 1826: the people “utilized three little islets that break the force of the current and deflect it, to construct quite expert fisheries. These are stone dikes forming small round enclosures with the opening towards the sea” (Museum of the Great Southern signage, quoting D'Urville, 1835). About the same site:

On the sides of this stream, as well as on the shores of Oyster Harbour, were seen the remains of several fish weirs, about eight to nine inches high ... some of these were constructed with loose stones, others with sticks, and stumps of wood ... (Dix and Meagher, 1976, p. 172, quoting Vancouver, 1789)

... as we walked along the beach towards it [*Kalgan River] we saw rude fish wares which did not bespeak much ingenuity in the contrivers; - they consisted of a row of small boughs of trees struck close together in the sand about two or three foot and kept close at the top by cross sticks along both sides fastened together with small withies and along their bottom some stones to prevent the fish escaping (Dix and Meagher, 1976, p. 172, quoting Menzies, 1791 who accompanied Vancouver). *brackets added by Dix and Meagher.

The oldest [@ 18 500 BP] evidence of occupation comes from the lowest ford on the Kalgan River, a spot where many of the main Aboriginal tracks came together. ... As well as the ford, it is also the location of stone fishtraps built only 500 meters downstream. The ocean tides extend up the river to the ford, and the Noongar elide on them to catch fish. When the tide was high, fish could swim freely among the rocks, but when the tide was low they would be trapped in the stone circles (Goode et al, 2005, p. 56, quoting Ferguson, 1987).

Oyster Harbour fish traps, southern end, photo by Pat Forster July, 2018
Some fish traps were wooden/brush structures that were situated across freshwater streams or tidal rivers (Gibbs, 2006). The Barragup mungah (fishtrap) is well documented. It was constructed in the lower reaches, at a narrow neck, of the Serpentine River, south of Perth (ibid).

A wicker fence was built across the stream, completely closing it from bank to bank, except in the centre, where a small opening was left. Through this opening a race was constructed by driving two rows of parallel stakes in the riverbed. The bottom of the race was filled with bushes, until there was only about eight inches of clear water above the bushes for the fish to swim through. On either side of this race was built a platform, about two feet six inches below the top of the water. On these platforms the natives stood to catch the fish as they swam through the race. The fish were caught by hand as they passed over the bushes and were thrown to natives who were waiting on the bank to receive them (Gibbs, p. 6, quoting Hammond, 1933).

The trap was used to catch marine fish which used the river as a nursery and were flushed down by water from the first winter rains. The were other wooden fishtraps on the Serpentine River, south of Perth and at Windy Harbour on the south coast (Dix and Meagher, 1976). Other fishing methods were that men, as a group, would corral fish and drive them to shore, and spearing (Gibbs, 2006). Sometimes these were in conjunction with temporary traps made of brush. “When a shoal of fish was sighted a watch was kept on it from the shore, or it was shepherded by a few aborigines, while the other members of the group, men and women, gathered bushes to construct an enclosure, which was built out from the shore in either a semi-circle or a rectangle” (Collie (Dix and Meagher, 1976, p. 181, citing Collie 1834)). An indication of size was Given by Collie as about 12 yards wide and about 20 yards long (ibid). “The enclosure was either built around the shoal of fish, or the fish were herded into it through a gap left during its construction. Once the fish had been enclosed they were either speared or taken by hand. Descriptions of such operations indicate that from ten to fifty people were engaged on any occasion. This method of taking fish was used mainly during summer and autumn” (Dix and Meagher, 1976, pp. 181-182).
Mass catches in fish traps, in season, supported large gatherings of people (Gibbs, 2006). Hence, harvesting with the fish traps is an example of Aboriginal ingenuity to secure large quantities of food. However, fishing caused friction between Aboriginal people and European settlers because of the need to gain access to traditional spots and the associated gatherings. In 1899, the construction and use of weir-type fish traps across waterways was prohibited in the (colonised?) southwest of WA (Tilbrook, 1983).

A search (16/03/2020) on the Aboriginal Heritage Inquiry System WA for ‘Registered heritage sites, Fish trap’, yielded eight results, Marbalup and Barragup described above, two others in south west WA, one in the West Kimberley, and one and an associated midden in the Pilbara. Clearly a more detailed search is needed to reveal all places where there are or were Aboriginal fishtraps.

4 WATER TREATMENT AND POLLUTION

4.1 Purification

Noongar Elder Kevan Davis explains: “Water kept our people alive, so gnammas were sacred. They were guarded and regularly cleaned. Slabs of rocks were placed over some smaller pit gnammas to reduce evaporation and prevent wildlife from falling in and drowning” (Wheatbelt Natural Resource Management, n.d., p. 5). When exploring east of Perth in Noongar country in 1836, Roe recorded in his diary (Hercock (Ed.), 2014):

The well which was 14 inches deep with water had once been roofed over by them with dead branches, and covered over with soil, leaving one small opening only, which they probably closed up when absent from the vicinity, in order to exclude all animals and birds’ (p. 247). Moore (1842) also noted: ‘The native is careful not to drink directly from stagnant water, but scrapes a hole in the sand at a little distance and drinks the filtered water. And even in springs he frequently inserts a quantity of grass-tree [Xanthorrhoea] leaves, so as to act as a strainer; this is to guard against swallowing insects, a precaution which might be prudently imitated by the settlers (p. 101).

For “Aboriginal people living a traditional life in the desert areas of Australia, water, and knowledge of where it could be found, was essential to survival. … Rockholes and other water sources were, and where possible still are, constantly maintained so that the water supply remains fresh and accessible” (Wroth, 2019a, webpage).

In the desert, where water runoff from rocks has seeped into the ground: “digging reaches the muddy water which is filtered with grasses laid on top and then scooped up with a vessel pressed into the grass. Sediment also settles in the vessel given a few minutes” (British Broadcasting Corporation, 2008).

4.2 Gnamma maintenance

As a general principle, “it is the right and responsibility of Nyungar to care for boodjar [country]” (Stocker et. al., p. 849), and this would have included gnamma. Further, “Water kept our people alive, so gnammas were sacred. They were guarded and regularly cleaned. Slabs of rocks were placed over some smaller pit gnammas to reduce evaporation and prevent wildlife from falling in and drowning” (Noongar Elder Kevan Davis, in Wheatbelt Natural Resource Management, n.d., p. 5).

“There are several reports of Aborigines (and later European pioneers) covering gnammas with branches or flat slabs of rock to cut down on evaporation, and to keep out wild animals which not uncommonly fell in and drowned, and thus polluted a precious supply of water” (Bayly, 1999, p. 20). “To prevent animals getting at the water, most of the rock-holes are partly or entirely filled with loose lying sticks, which practice, necessary as it may be to save the
water, deteriorates its quality considerably by making it often look quite black and giving it a fetid smell and taste” (Bindon, 1997, p. 173, quoting Helms, 1892). “Aboriginal people have indicated to me [Bindon] that the sticks allow animals to reach the water, drink and climb out of the hole without being stranded and dying by drowning. The sticks thus prevent contamination by animal carcasses” (Bindon, 1997, p. 174).

4.3 Gnamma degradation
In their recent analysis of the current state of gnamma in international locations and in WA, Fiedler and Hopper (2016) identified degradation in the form of poor water quality, and through trampling and sedimentation, smashed rocks and vandalism, and fragmentation of gnamma complexes by development - such as a road through a complex. As well (ibid), low walls constructed on granite outcrops for collection of water for dams, a common site in the Wheatbelt of WA including at Wave Rock, have diverted the natural flow of water into and out of gnamma. Other construction has occurred on gnamma sites such as the concrete-wall receptacle to collect water at King Rock, WA. Fiedler and Hopper call for greater stewardship of gnamma, with their main interest being protection of fauna and fauna that depend on gnammas, and the associated biodiversity.
4.4 Other degradation

On interference with rivers, Noel Nannup says:

Unfortunately, it has taken a long time for people to recognise the importance of our waterways, and in the meantime a lot of harm has been done. Felling trees and fertiliser over-use have damaged our river systems. The *Derbal* (Swan River) looks *mindytych*, which means sick in Nyungar language. It just lies there asleep. It has been doing that for a long time because it needs help, but the help is slow in coming ... We have got to stop it [polluting the river] because of our spirit. When the river is healthy, we are healthy (in Morgan et. al., 2008, pp. 108-109).

4.5 Water storage

Water was stored in gnamma, for which erosion was hastened by firing -the increased depth of the gnamma prevented drainage. Thus intervention by Aboriginal people increased the storage capacity, and lowered the evaporation rate by increasing the depth to surface area ratio. Also, some pit are wider underneath than on the surface, which also reduces evaporation. The small flask shaped gnamma on Lillian Stokes Rock in Wheatbelt, south west WA is an example (Timms, 2013). In another two cases in the Wheatbelt, a deep horizontal joint has been hollowed underground naturally (ibid). “In both cases the horizontal extent of the cavity is unknown, but at least 50 cm on one side of Wattoning Gnamma and probably much bigger in the case of Horse Collar, as it was known in the early days to water stock without drying, despite its visible small volume” (Timms, p. 9).

In contrast to the ingenious use of gnamma as a water source, Aboriginal means for storing water for transporting it away from source were extremely limited. Moore’s (1842) Noongar vocabulary lists: mya Bark of the Paperbark (*Melaleuca*) tree. “A piece of the bark placed in a hollow scooped in the ground is used by the natives to hold water. Also a piece folded into the shape of a cup is used for drinking” (p. 60). A larger vessel, the yandi, was made of a piece of bark cut from a tree and was used to carry water, fruit, seeds, babies, amongst other things; the trees then became scar trees (Jaworski, n.d.). Yandis were cut from the tree with a stone tool and “once the piece of bark has been removed from the tree it is then moulded over the fire which gives it its curved edges. Once this process is finished the yandi needs to be propped up .... so to stand for a few days so it doesn’t lose its new shape. To help preserve and protect the yandi they were regularly rubbed with animal fat (eg. emu)” (Jaworski, p. 1).

Aboriginal people in the Broome area (West Kimberley coast) used baler shells to transport water (Sullivan in Peterson and Rigsby (eds), 2014). Large balers can carry several litres. Use of macropod skin water carriers is reported for Australia (Macfarlane and McConnell, 2017), but there don’t seem to be references for Western Australia. Similarly, kelp water carriers were used in Tasmania, but don’t seem to be referenced for Western Australia. On a larger scale, torrential rain served/serves to increase the water naturally stored in acquifers and in sub-surface flows (Macfarlane, 2017).

**Scar tree near Oyster Harbour, south coast, WA. Potentially, the bark was used to make a yandi. photo by Pat Forster 10/07/18**

In summary of this section, ‘Water treatment and pollution’, traditionally Aboriginal people took simple steps to towards ensuring available water was drinkable. While the enlargement of gnamma was ingenious, other actions to facilitate the storage and transport of water were minimal. Current degradation of water sources includes neglect of
gnamma and pollution of rivers. Besides practical implications, degradation can have spiritual ramifications for Aboriginal people.

5 MEDIA

5.1 Water symbols

“Important cultural stories are portrayed and communicated through the generations by symbols/icons through their artwork. These vary from region to region but are generally understood” (Artlandish Aboriginal Art Gallery, n.d. a, webpage). They include concentric circles for water sources and campsites, wavy lines linking sets of concentric circles for running water between water sources, straight lines between sets of concentric circles for tracks between water sources, and four upside down Us spaced around a set of concentric circles for people sitting (Artlandish Aboriginal Art Gallery, n.d. b, webpage).

Language

Moore’s (1842) Noongar vocabulary contains many words that relate to water, an indication that accurate identification was important. See Table 1.

Table 1 Noongar words related to water (Moore, 1842)

<table>
<thead>
<tr>
<th>English word</th>
<th>Noongar word</th>
</tr>
</thead>
<tbody>
<tr>
<td>stream/creek, river</td>
<td>bilo</td>
</tr>
<tr>
<td>estuary</td>
<td>willa, darbal</td>
</tr>
<tr>
<td>a hollow or swamp with a little water</td>
<td>gotyn</td>
</tr>
<tr>
<td>swamp</td>
<td>bura, mulyin, yalgor</td>
</tr>
<tr>
<td>small lake or basin</td>
<td>ngura</td>
</tr>
<tr>
<td>large lake</td>
<td>mulur</td>
</tr>
<tr>
<td>water</td>
<td>gabbii</td>
</tr>
<tr>
<td>fresh water</td>
<td>gabbidjikap</td>
</tr>
<tr>
<td>flowing spring, fresh water</td>
<td>gabbigarjet</td>
</tr>
<tr>
<td>saltwater in lakes/rivers</td>
<td>gabbikarning</td>
</tr>
<tr>
<td>saltwater of the sea, sea water</td>
<td>gabbiodern</td>
</tr>
<tr>
<td>running water</td>
<td>gabbikolo, gabbytch</td>
</tr>
<tr>
<td>discoloured stream of fresh water,</td>
<td>gabbiyurro</td>
</tr>
<tr>
<td>which descends after rain in the</td>
<td></td>
</tr>
<tr>
<td>uplands</td>
<td></td>
</tr>
<tr>
<td>water standing in a pool</td>
<td>gabbiarri</td>
</tr>
<tr>
<td>well of water</td>
<td>gnura</td>
</tr>
<tr>
<td>a hole or pool of water in a rock</td>
<td>ngamar, amar</td>
</tr>
<tr>
<td>pool in a river</td>
<td>monong</td>
</tr>
<tr>
<td>warm (adj); warm water</td>
<td>kallang; gabbikallang</td>
</tr>
<tr>
<td>shallow, not deep (adj)</td>
<td>danjal</td>
</tr>
<tr>
<td>deep (adj)</td>
<td>didaral</td>
</tr>
<tr>
<td>dried up (adj); dried up lake</td>
<td>datta; ngura datta</td>
</tr>
<tr>
<td>dry, parched up (adj)</td>
<td>gulbar</td>
</tr>
<tr>
<td>mud</td>
<td>nano</td>
</tr>
</tbody>
</table>

5.2 Placenames

Aboriginal place names provide significant information about that place including the presence of water. Names are important for memorising and following Songlines and other routes (Bayly, 1999). Placenames from Noongar Country include:

- Gabbi Darbal (estuary), the place where salt and freshwaters mix (Kaartdijin Noongar-Noongar Knowledge, n.d. b)
- Quaada Gabee (Bicton foreshore) from Quaada beautiful, Gabee water (freshwater springs) (City of Melville, n.d.)
- Gabbiljee (Bull Creek-creek area), watery place at the end of the river (City of Melville, n.d.)
- Gabbikalga (area in Kings Park near the Queen Victoria statue), where there was a hollow tree which collected rainwater (Department of Biodiversity, Conservation and Attractions, n.d.)
See Forster (2020) for a review of Noongar placenames of places associated with water—not only do they reference water, but also flora and fauna at the places, shapes and other properties of the places, activity at the place and spiritual connections.

5.3 Art

“Rock art sites are generally associated with water holes and rock pools” (McDonald and Clayton, 2016, p. 37). Burgess Point, Mourambine Kariyarra and South West Creek are three significant rock art places in Port Hedland.

Burgess Point is a limestone site complex and a midden scatter surrounded by mudflats fringed with mangrove. The art includes symbols that are generally associated with water: circles, concentric circles, meandering lines, and lines. Mourambine Kariyarra is an island site complex with engraved motifs... The site is very well preserved, and is associated with South West Creek 250m northeast, and separated by a small water channel. There are approximately 10,000-20,000 motifs, depicting ... circles, concentric circles, meandering lines, ... (p. 37).

Water is symbolised differently on Wandjina that are painted in rock art galleries in the Kimberley. Water related symbols include that: “The eyes of the Wandjina can represent thunderstorms ... Small brush marks on the Wandjinjas body usually represent rain drops. When depicted with only head and shoulders the Wandjina is said to be moving across the sky in a cloud or storm” (Wroth, 2019b, webpage). See more about the Wandjana above, near the end of Creation narratives.

In today’s Aboriginal acrylic paintings, “symbols are at the core of the painting, and at one level they contain some meaning of the painting. At another level, they’re just part of the language that the artist uses to tell the story. We have to be brought into the meaning of those particular paintings before those symbols can start to reveal to us what the artist is talking about” (Wroth, n.d., webpage).

5.4 Maps

5.4.1 Star maps

Josie Boyle, Wongai Elder, when describing the Seven Sisters songline in the Eastern Goldfields (in Goldsmith, 2014), referred to a star map:

I was only sitting down with my son of law who grew up out there, ... and I was talking to him about the distances between sites ... There are about six that are out there still. I was asking him the other day, how much distance is between Gindowee, and Niagra Falls [dam], and Boorley Well, and another site out there, and there are six out there, and why are they are zigzagged, and he said, well, he looked at it that there were six out there specially because they were aligned to the stars (p. 516).

Noongar Elder Noel Nannup describes how stars, linked with imagined lines, depict routes on the ground between water sources and other landscape features (British Broadcasting Corporation, 2017, video). Star maps seemed to have been used to teach the route rather than for real-time navigation (Norris, 2016).

5.4.2 Sand maps

Wongi Elder Josie Boyle (in Goldsmith, 2014), speaking about her mother explains:

She came from (Ooliar?) [Ooldea Soak in South Australia?], see, and they did lots of journeys across the Nullarbor, straight across the Nullarbor where the railway line is today. ... That was the walking path of those people, my people, that walked from (Ombi?) [Ooldea Soak?], long time ago, for ceremonies for star stories ... Everybody coming together all singing the songs of the earth and sky songs, you know, ... and see she drew these things in the sand (p. 520-521).

Almost certainly it can be said that ‘These things’ included water sources.

The area for each sand painting [for ceremony] is always carefully prepared, the ground is cleared and the surface is spread with termite-nest gravel mixed with water to a paste, when dried this hardens to give a firm surface. The senior lawmen then create the Dreamtime story showing, land, animals, plants and spiritual symbols; created with sand, ochres, leaves, feathers and sticks. The designs can be a series of round circles, wavy lines, mounds or any of the many symbols that represent their Dreamtime journey and the land that it represents (Red Desert Dreamings, n.d., webpage).

5.4.3 Painted maps

An example: The story of the Seven Sisters Songline starting in Roebourne, “is told in ceremonial dance and song, linking together distant country, recounting the locations of important water places. It has been painted on the walls
of Walinyna (Cave Hill, northeast of Amata in the Musgrave Ranges, SA) ... in the last four decades elements of the Songline have frequently painted in acrylic form... “ (Macfarlane and McConnell, 2017, p. 65)

5.4.4 Body-paint maps
Recent filming of places along the Seven Sisters Songline that starts in Roebourne, “shows that the significant waterholes along the Songline are undisturbed. .... When people paint the places of the Seven Sisters Songline, the women sing the songs so that the land is built into the painting. For example, Inawinytji Williamson, based at Kaltjiti (Fregon, SA) paints the different inma walka — the marks painted on women’s breasts as they dance the parts of the story, representing different places along the path of the story” (Macfarlane and McConnell, 2017, p. 65)

5.4.5 Engraved maps
“Rock art in Port Hedland consists of engravings” (McDonald and Clayton, 2016, p. 36). The sites, Burgess Point, Mourambine Kariyarra and South West Creek “share their importance as containing motifs (Minjiburu) that connect a mythological narrative from the Pilbara coast to the arid interior” (McDonald and Clayton, 2016, p. 37).

Donald Thomson, writing of The Bindibu Expedition, among the desert Aborigines of Western Australia in 1957, describes wood engravings:

Just before we left, the old men recited to me the names of more than fifty waters – wells, rockholes and claypans ... this, in an area that the early explorers believed to be almost waterless, and where all but a few were, in 1957, still unknown to the white man. And on the eve of our going, Tjappanongo (Tjapanangka) produced spear-throwers, on the backs of which were designs deeply incised, more or less geometric in form. Sometimes with a stick, or with his finger, he would point to each well or rock hole in turn and recite its name, waiting for me to repeat it after him. Each time, the group of old men listened intently and grunted in approval – “Eh!” – or repeated the name again and listened once more. This process continued with the name of each water until they were satisfied with my pronunciation, when they would pass on to the next. I realized that here was the most important discovery of the expedition – that what Tjappanongo and the old men had shown me was really a map, highly conventionalized, like the works on a “message” or “letter” stick of the Aborigines, of the waters of the vast terrain over which the Bindibu hunted (Bayly, 1999, p. 17, quoting Thomson, 1962).

A drawing of a photograph of the map in Bayly (1999), indicates the engraved symbols comprised concentric circles, spirals, and straight and curved lines. “Tindale (1974) reproduced a comparable “map” of water resources prepared by Katabulka of the Ngatatjara [Ngaatjatjarra] tribe in the Warburton Ranges of Western Australia. This again used spirals to show the location of pools and soakage-wells” (Bayly, p. 18).

5.4.6 Oral maps
Songs and stories guide journeys along Songlines, the tracks of spirit ancestors. The tracks also link water sources, so the songs and stories serve as oral maps that point to water. More than that, “the Songlines are heavily imbued with the minutely detailed, practical information necessary for survival and for maintaining cultural integrity” (Sheppard, 2016, webpage, interview report with author of The Memory Code, Kelly, 2016). They:

- contain thousands of years of collated information about plants, animals, landscape [including water sources], weather, star systems, navigation, ethics and lore, resource use [water] rights, genealogy and marriage rules.
- Ancient oral cultures knew that the brain easily associates physical place with remembering information. In a Songline, each location in a landscape has attached to it an instruction about the relevant song, dance, story, character or all of those. In those songs and stories is all the information about a particular thing that people needed to remember, as well as the rights and responsibilities attached to that information (ibid).

Further, fun stories are easy to remember and “I think what has been lost out of all of this is the practical intellect, the intellectual property. Development going ahead on Indigenous sacred sites is effectively the same as burning down a university. It is the intellect that we westerners value so highly and it is there. We just couldn’t see it” (Sheppard, 2016, webpage, quoting Kelly).

5.4.7 Modern maps that record or propose water-source history
In 2009, Kumpaya Girgirba, who was born near Kiwirrkurra in the tali (sandhill) country of the Gibson Desert, Western Australia, and who walked around that area with her family as a young girl until the 1960s, displayed, by scratching on a film negative, her phenomenal memory of the area: “she unerringly named these water sources as she scratched their outlines into the negative’s emulsion” (Wangka Maya Pilbara Aboriginal Language Centre, n.d., webpage). She drew a single circle for each place.
Desert waterholes are subject to being buried over by moving sands, and need to be maintained. ... As the number of Aboriginal people living in the desert declined over time... many desert waterholes were buried by sand and largely forgotten about. ... The loss of these waterholes has also affected the populations of animals, which cannot access the water without the help of human intervention. The Spinifex people who live in the Great Victoria Desert in the south-east corner of Western Australia have been revisiting waterholes that they knew when they were children, over 50 or 60 years ago. ... The plan is to locate and map these ancient sites, and record them using a GPS location. As adults the people were able to re-trace the locations of small waterholes in the desert, based on their own memories from long ago. Once they could locate the waterholes, the modern technology provided a GPS location, so now the position of waterholes will be recorded, even after the old people whose families lived there for thousands of years, may have passed on (Japingka Aboriginal Art, n.d., webpage).

In his thesis on Aboriginal Dreaming Tracks or Trading Paths: The Common Ways, Kerwin (2006) provides several maps. One, derived from oral history accounts by Noongar Elder Noel Nannup and Ngalia lead Kado Muir, shows the historical trade route for pituri, a tobacco, which includes routes close and parallel to the west and south coasts of Western Australia, east from Monkey Mia, and south from Wyndham (p. 67). The route would necessarily have been punctuated with water sources. It is interesting to compare this map with one proposed by Bird et al (2016) for dispersal of Aboriginal people when they first came to Australia (the Pleistocene dispersal). Their map is based on the premise that the “distribution of potable water provided a primary constraint on dispersal pathways” (p. 11477). Data came from the “Australian Water Observations from Space dataset combined with the distribution of small permanent water bodies (springs, gnammas, native wells, waterholes, and rockholes). They concluded that 84% of archaeological sites >30,000 y old are within 20 km of modern permanent water. We further show that multiple, well-watered routes into the semiarid and arid continental interior were available throughout the period of early human occupation. Depletion of high-ranked resources over time in these paleohydrological corridors potentially drove a wave of dispersal farther along well-watered routes to patches with higher foraging returns” (p. 11477). Like the map by Kerwin (2006), the map produced by Bird et al shows routes parallel to the west and south coasts of Western Australia, and from approximately Monkey Mia - south-east then east. In addition, the map of Bird et al shows two short routes starting on the west coast and going inland.

5.5 Stone arrangements
Some traditional Aboriginal stone arrangements point to water. For example, at Shackleton in the wheatbelt (south west, WA) a circle of rocks on the ground has an added triangle of rocks on the end that points to where permanent water could be found, and there is another at Mukinbudin in the wheatbelt (Wheatbelt Natural Resource Management, n.d.).

In summary of this section on the ‘Media’ which facilitated communication about water, water was represented symbolically in painted and engraved rock art, sometimes mapping water sources, and in sand and body-paint maps, and on engraved wooden spear throwers and potentially on message sticks. Noongar people, for example, had oral language for water of many different descriptions, and placenames provided information about water. Songline stories and songs functioned as oral maps. Star maps correlated with locations of water on the ground such as granite outcrops.

6 APPROPRIATION OF WATER SOURCES BY EUROPEAN EXPLORERS AND SETTLERS

Four examples are provided below of colonial settlers and explorers appropriating water sources for their personal use.

6.1 Perth example
Drainage of the swamps began in 1833 for commercial purposes with the construction of drains to power Reveley’s and Kingsford’s mills. As Perth expanded northward, more swamps were drained for market gardens and new town lots. After 1834, wetlands increasingly diminished on Perth’s town plans. Whereas the 1833 town plan had plainly stated the presence of “fresh water swamps with rushy margins”, the 1838 maps show the swamps overlaid by roads and absorbed into the town plan with the effect of making the lakes vanish incrementally as if they had never existed (Western Australian Museum, n.d. b, webpage).

The effects were catastrophic for Aboriginal people who traditionally had access rights to those areas - no longer could they draw fresh water, or gather swamp foods on which they relied, particularly reed roots which were a carbohydrate staple (Hallam, 1991).
6.2 Eastern Goldfields example

McLeod relates a story told to him by an old prospector by the name of Long, observing an Aboriginal man and woman: The man took the throwing stick he was carrying and worked it into the sand. He then broke off a hollow reed and, placing it in the hole he had thus developed, lay down on his stomach and appeared to suck up something through the reed. His companion repeated his movements before they quietly moved on. Without delay Long, with the aid of a shovel, proved the existence of a soak of sweet water, from which he replenished his supplies...Only a few days later in the same place, another prospector had the same Blackfellow bailed up, threatening to shoot him unless he revealed a source of water. This was certainly not an untypical bush encounter. However, [they were] interrupted by yet another prospector riding a camel. The Blackfellow took advantage of the confusion and threw a spear into the bush and escaped. On the diggings, a hue and cry was raised over this alleged murderous attack and a party was quickly organised to set out and teach the Blackfellows a lesson - for daring to protect their water. Mustering what guns they could, the punitive party went out to what later became known as Skull Creek, and shot every Blackfellow they could find. The bodies were buried in shallow graves (Wikipedia, n.d., webpage, quoting McLeod, 1984).

6.3 Pilbara example

Weld Springs in the Pilbara, on what is now called the Canning Stockroute, was the scene of a tragic event: “Martu people call this area Palatji. For generations it has been an important source of water (kapi), food (mirrka) and other resources. ... John Forrest and his exploration party travelled through this country ... In June 1874 they arrived at Palatji naming it Weld Springs ... Forrest spent two weeks camped at the springs” (Western Australian Museum, n.d. a, webpage). On the seventh day there was a confrontation. According to Forrest’s diary:

I was surprised to hear natives’ voices, and, looking towards the hill, I saw from forty to sixty natives running towards the camp ... I was cool, and told Sweeney to bring out the revolvers ... One advanced to meet me and stood twenty yards off ... All at once one from behind (probably a chief) came rushing forward ... He went through many manoeuvres, and gave a signal, when the whole number made a rush towards us, yelling and shouting, with their spears shipped. When within thirty yards I gave the word to fire ... I think the natives got a few shots, but they all ran up the hill and there stood, talking ... They all descended from the hill and came on slowly towards us. When they were about 150 yards off I fired my rifle, and we saw one of them fall, but he got up again and was assisted away ...[next day] The natives did not return to the attack last night. In looking round camp we found the traces of blood...This must have been the foremost man, who was in the act of throwing his spear ... Two therefore, at least, are wounded (Forrest, 1875, digital version - no page numbers).

The Martu tell the story much differently: “It was night time, ..... old people sitting down around fire singing. 20 yards away old people saw him, a white one. One man got up and tried to spear him, they shot him, then shot another. Next day old people tried to come to get water at the spring. They had built a fort, biggest mob came in – they killed ‘em, dragged ‘em like a dog...” (Western Australian Museum, n.d. a, webpage, quoting Senior Martu man, 2010).

 Sketch by G.f. Angus of the attack (Forrest, 1875) [http://gutenberg.net.au/ebooks/e00051.html](http://gutenberg.net.au/ebooks/e00051.html)
6.4 Canning Stock Route example
In 1906, Alfred Canning was appointed to survey a stock route from Halls Creek in the East Kimberley to Wiluna in the mid-west.

Canning’s acknowledged strategy for survival and success in finding water for the stock route was to capture and chain Martu [local Indigenous people], forcing to lead his party to known water sources. ... This early cruelty has set an enduring precedent for Martu perceptions and experiences of white authority. Chaining was increasingly used after Canning’s ‘success’, such that the practice became synonymous with white authority: the Martu words for ‘policemen’ which survive today are ngalyikarrpil, referring to ‘chain around the neck’, and mantamarangka, a ‘chain in hand man’ (La Fontaine and Carty, 2011, p. 334).

After surveyors located water on the basis of forced information from local people, they made the waters inaccessible to them through the construction of the Stock Route wells (McFarlane and McConnell, 2017).

Bayly (2002), in his paper ‘Australia’s Early Water Wars: Aborigines versus European Explorers’, identifies other examples of appropriation which were in the name of explorers’ survival in arid regions. Often it was to water thirsty horses, which drank a lot, and/or camels which drank even more. The water was needed by Aboriginal people for their survival, and the quantities consumed were immense in relation to the amount of water available. Another problem was explorers camped beside the water sources, rather than away from them which allows animals to come in, so Aboriginal people were also deprived of a food source. In some cases, like for Forrest, the Aboriginal people retaliated and then were punished for that. Ernest Giles party, when near Warburton WA in 1873, and David Carnegies party on their trip from Coolgardie to Halls Creek and return 1896-1897, are mentioned. Carnegie engaged in soak sucking—a “process of repeatedly digging out soakage wells and bailing out every skerrick of water that seeped inwards” (p. 44) and another time worked on a large rock hole in a stream bed, digging out sand and gravel, and drained the hole (Bayly citing Peasley, 1995). Bayly suggests the water wars have now shifted to other levels: “farmer against farmer, cotton farmers against graziers, State versus State and States versus Commonwealth” (p. 39).

In summary, the four examples and those provided by Bayly (2002) demonstrate gross disregard towards Australia’s First People and are entirely counter to the Aboriginal ethos of sharing. They belie that colonial occupation was peaceful.

7 IMPLICATIONS FOR WATER MANAGEMENT TODAY

McDonald et. al. (2005) made a number of recommendations for future water-management as a result of their ‘Study of Groundwater-Related Aboriginal Cultural Values on the Gnangara Mound, Western Australia’. The study found that groundwater-related spiritual values which centre on the Waugal are of primary importance for Noongar people. “Many Nyungars believe that the spirit of the Waugal still inhabits deep water and that its life force is present in flowing water. The health and wellbeing of the Waugal is directly connected to the vitality of the groundwater features, and both are intertwined with the health of Nyungar cultural identity. ... Aboriginal people consistently request that water flow and vitality and associated ecological values (e.g. important natural habitats) be protected from development. ... One of the key principles in managing Aboriginal heritage issues is to ask first and those consulted welcomed the opportunity to contribute to this study” (p. 2). Key recommendations “aimed at avoiding further negative impacts on groundwater-dependent cultural values” (p. 2) are to:
- limit drawdown of groundwater,
- preserve and restore wetlands, and
- preserve waterflow.

Based on the crocodile narrative (see Creation narratives referencing other spirit-creatures, above), with the taboo on mixing salt water and fresh water, another recommendation would be to prevent urban development and mining that could result in the intrusion of salt water into ground water aquifers or the salination of surface water. Other recommendations by McDonald et. al. (2005) include:
- building the capacity of Nyungar people to participate in the planning process, and
- building the capacity of Departmental staff and those of other agencies to work effectively with the Indigenous community.

The above recommendations that derive from Noongar culture could also be well applied to Western Australia in general, indeed, to Australia in general. Advice by the Australian Government (n.d.) on ‘Indigenous principles for water quality’ includes that:
- Indigenous people acknowledge the environment as a living entity. It follows, if a water source dries up due to over-extraction or becomes polluted, the cultural significance can be lost forever.

- Indigenous people have a deep relationship with their land, sky and waters through traditional knowledge, including ethnobiological and botanical knowledge. It follows that local Indigenous people need to be consulted if any activity will affect the natural cycles.

Indigenous hydrologist Bradley Moggridge, who works to integrate traditional knowledge with the science of hydrogeology, advises: “Many traditional rites and activities are triggered by water-related phenomena, such as particular species of fish spawning, or particular types of plant going into flower. Keen awareness of these, viewed through the prism of observations made over millennia, promises acute insight into changes in the health of river and groundwater systems” (Masterton, 2017, webpage). Other signals include decreased water flow in rivers over increasingly long periods.

Two suggestions that complement the above seem to me to flow from my review. First comes from the ideal that (tribal) ownership brought with it responsibility of custodianship, and gave control over water which included sharing, to enable survival of all. Survival also depended on knowledge of water sources by season and by changing weather pattern, including extended drought. Could it be that the present-day custodians of water design allocation of it and charges for it to be responsive to weather patterns, more than is done at present? That is, set in place allocation and charges, according to levels of rainfall (immediate past, present and predicted) and other signals such as depletion of aquifers. Second comes from the role of (Dreaming) narrative to identify moral attitudes to water, and to mediate a respectful, sometimes fearful, attitude to water and that it is something to be shared. The current range of media for conveying messages is huge compared to the traditional media described in this review. Could creative media minds facilitate increased awareness among Australians that fresh water is something to be valued and not used indiscriminately, and educate about simple ways to reduce water consumption, noting that fun narratives, with repetition, are memorable?

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