‘On the top of a mountain I saw the figure of a man’: An analysis of the relationship between visual perception and the engraved art of the Sydney-Hawkesbury region using GIS and the concept of affordances.

Thesis submitted in partial fulfilment of the requirements for the Bachelor of Arts (Honours) degree in the Department of Archaeology at the University of Sydney

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Cover: View from Frying Pan Rock.

Photo taken by the author

Statement of Authorship

The research described in this thesis, except where referenced, is the original work of the author and was supervised by Dr James Flexner. This thesis contains no material published elsewhere and has not been submitted for the award of any other degree or diploma in any other tertiary institution.

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Abstract

The last 2 decades have seen intensifying interest in rock art and the senses. This perspective stems from the recognition that sensory perception is at the core of human experience and is culturally variable. GIS methods are frequently used in this context as they are capable of complex mapping and data manipulation exercises. Such investigations have led to new understandings of the spatial patterning of art sites around the world. Despite the potential benefits of this approach, it is not commonly taken in Australia, where functional explanations of rock art are prevalent.

This thesis aims to develop a new appreciation of Australian rock art by investigating the relationship between visual perception and engraving sites in the Sydney-Hawkesbury region. Two national parks in the region, Ku-ring-gai Chase and Yengo, form the study areas for this thesis. A total of 85 sites in these parks were subjected to a GIS-based visibility analysis focusing on the visual affordances of the landscape. Affordance is a concept used in other visibility analyses that formulates the landscape as an arena of potential decision-making. By interrogating the visual affordances of the landscape, the patterns in the co-occurrence of engraved art and places with panoramic views are brought to light. Visual perception was also investigated in relation to motif rarity and movement. The results of the analysis suggest visually impactful places were often (but not always) targeted for the production of engraved art. The results also indicate a link between visual perception, Dreaming tracks and ceremonial activity. This thesis provides a more comprehensive view of engraved art in the Sydney-Hawkesbury region. It also identifies sensory perception as a theme that may benefit Australian archaeology upon further investigation.

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CHAPTER 1. INTRODUCTION AND RESEARCH AIMS

Introduction

Sensory perception is as much a cultural activity as a biological one (Classen 1997). The role of the senses in apprehending, structuring, and understanding the world is now widely acknowledged by anthropologists (Bille 2013; Bull et al. 2006; Classen 1997, 2012; Classen, Howes, and Synnott 2003; Degen and Rose 2012; Howes 1991, 2003, 2006, 2019; Ingold 2011; McClintock 2013). Developments within the field of landscape archaeology have also witnessed a turn to the senses. Archaeologists acknowledge not only the cultural aspect of the senses but also the ability to archaeologically investigate them (e.g. Bradley 1991, 2005; Day 2013; Gosden 2001; Hamilakis, Pluciennik, and Tarlow 2002; Kus 1992; Skeates and Day 2020; Watson and Keating 1999). Sensory archaeology does not seek to see, taste, smell, or generally experience the world in the same way as past people have. Rather, the goal is to understand the role of the senses in shaping people's experiences, identities, politics and histories (Hamilakis 2013). Sensory archaeologists seek to understand how the senses may have operated within different social and environmental contexts.

Research examining relationships between archaeological features and sensory perception has flourished in Europe and the Americas (e.g Gillings 2009, 2012, 2015; Llobera 1996, 2003; Scarre 2002; Wernke, Kohut, and Traslaviña 2017) and has demonstrated a link between rock art and the senses (e.g. Ouzman 2001). In

many instances research has focused on whether locations possessing certain auditory and/or visual qualities were targeted to produce rock art (e.g. Goldhahn 2002; Allen et al. 2013), and these investigations have had beneficial multidisciplinary interactions with GIS methods (e.g. Díaz-Andreu et al. 2020, 2019, 2017; Mattioli and Díaz-Andreu 2017; Felding 2015), as well as with the concept of affordances (e.g. Gillings 1998). Affordance is a useful heuristic device, discussed in Chapter 2, that highlights opportunities for action.

The rock art of the Sydney-Hawkesbury region (also referred to as the Sydney Basin) is generally explained in functional terms. It is thought to be a product of symbolic activity involved in networks of communication (McDonald 1999, 2000, 2008). Although secure chronological frameworks remain elusive, there is evidence suggesting engraved art in the region has a potential maximum age of ~5,000 BP (McDonald 2008). This period broadly coincides with rising sea levels and increased aridity, which followed a period of climatic stability and population growth (Williams 2013; Williams et al. 2013, 2018). The engravings of the Sydney Basin are argued to have operated within a political landscape to communicate group identity and to facilitate broad-scale group bonding during a time of heightened territoriality caused by demographic and climatic stress (McDonald 2008). This framework has been supported by research in other places around Australia, including Cape York and Central Australia (David and Lourandos 1998; McDonald and Veth 2012; Morwood 1987).

Critiques of functional interpretations of rock art focus on their self-perpetuating nature (Jones 2017), their variance with ethnographic data (Layton 1992) and their lack of social context (Rosenfeld 1997). Archaeologists are thus left with a stagnant model of symbolic behaviour for the duration of human presence in Australia

(Rosenfeld 1997, 289–90). Recent work has attempted to overcome some of these critiques by investigating socio-demographics and intra-regional stylistic variation (David and Lourandos 1998; McDonald 1998, 1999). Nonetheless, functionalism remains fundamental to current explanatory frameworks, which neglect other equally important aspects of rock art.

This aims to approach the rock art of the Sydney-Hawkesbury region (see Figure 1) through a GIS-based landscape analysis of rock art and visual perception. There is little to no ethnographic information pertaining to the rock art of this region. Early European and later colonial accounts of Sydney only briefly mention the engraved art; however, when engraving sites are mentioned, it is common for the authors to refer to the art's location in areas with expansive vistas. Anecdotal evidence of this relationship persists in the modern literature, resulting in a general association between engraved art and extensive views of the surrounding landscape (see Table 1). Conversely, it is possible modern researchers believe this relationship exists because of an inherited way of looking at landscapes (B. W. Smith and Blundell 2004).

Was visibility of the landscape (i.e. projective 'views-from' engraving sites; see Loots 1997; Wheatley and Gillings 2002, 188) a factor in the placement of engraved art in the Sydney-Hawkesbury region? To answer this question, affordance-viewshed maps were created for two national parks in New South Wales: Ku-ring-gai Chase, located north of Sydney (Figure 2), and Yengo, located in the Central Coast hinterland zone (Figure 3). These models were created using a Shuttle Radar Topography Mission (SRTM)-derived Digital Elevation Model (DEM) of each national park, with a DEM grid resolution of 1 arc second. The locations of 32 engraving sites

within Ku-ring-gai Chase National Park and 52 sites within Yengo National Park were plotted against these affordance-viewshed models.

Visual perception is conditioned by the sociocultural context in which it takes place and should therefore be investigated in terms of social context. The Dreaming (also referred to as the Dreamtime or Storytime) is a complex socio-cultural institution that was likely present across Australia during prehistory (David 2002). It constitutes a totalising frame of reference and 'corresponds to absolute or whole reality, that which comprehends everything and is adequate to everything. It is the total referent of which anything else is a *relatum'* (Stanner 1989, 26, in David 2002, 17, emphasis in original). Therefore, as David (2002, 16-28) notes, the Dreaming is multifaceted. It encompasses morality, time, law, social relationships, and experience. It has a strong religious aspect and prescribes rituals of various types, as well as totemic relationships to country.

As such, visibility may have played a role in ceremonial activity in ancient Sydney. Engravings, and sites with culture hero (or Biaime/Daramulan) motifs (see Chapter 4) especially, have been interpreted as being involved in such activity (see Table 2; Elkin 1949; Mathews 1905; McCarthy 1961; McDonald 2008). Based on motif frequencies reported by McDonald (2008), culture hero motifs are also among the rarest in the region. Many authors (e.g. Conkey et al. 1980; Díaz-Andreu et al. 2017; Franklin 2004; McDonald 1998, 1999, 2000, 2008, Wobst 1977) argue that stylistic variability is linked to behavioural change. Given the potential ceremonial nature and rarity of culture hero motifs, the levels of visibility at these sites may give an indication as to whether visual perception had a role in traditional Aboriginal religious life.

The Dreaming is also characterised by geographical mapping and is inextricably intertwined with people and the landscape: 'Individuals are related to places by virtue of their own relationship to the various Dreamings that identify the land' (David 2002, 25). Therefore, another variable likely to influence visual affordances of engravings is the proximity of rock art to travel routes, or 'Dreaming tracks'. The Dreaming refers to a formative mythological age when ancestral beings or spirits interacted with each other and the landscape, shaping the land into its present form and providing the basis for viewing the Dreaming as mapping.

In the lands of the Gandangara people, the story of Mirragan and Gurangatch (a Tiger Cat and a Rainbow Serpent, respectively) details how the Wollondilly River was created: after Mirragan tried unsuccessfully to spear or poison Gurangatch, the latter fled his waterhole home and 'commenced tearing up the ground along the present valley of the Wollondilly, causing the water in the lagoon to flow after him' (Mathews 1908, 204). Such stories involving Rainbow Serpents and other Dreaming beings are present in the oral histories and rock art of many locations across Australia (Smith and Jennings 2011; Taçon, Wilson, and Chippindale 1996). The routes taken by Mirragan, Gurangatch, and countless other Dreaming spirits as they shaped the present landscape formed 'Dreaming tracks' or 'songlines'. These tracks form travel routes connecting Aboriginal people, often across great stretches of country (e.g. Taçon 2008), for ceremonial, social, and economic reasons (Witter 2007; Franklin 2004, 161).

Importantly, the Dreaming both structures and maps geographical space via embodied experience (Tamisari 1998, 250), and these aspects of the Dreaming form the core principles upon which this thesis derives its analysis. Rock art is likewise widely understood to be involved in the socialisation of the landscape, or in turning

‘space’ into ‘place’ (see Ingold 2016; e.g. Balme et al. 2009; Brady and Bradley 2014; David and Wilson 2002; Dibden 2019; McNiven and Brady 2012). Rock art is known to have a spatial relationship with Dreaming tracks (e.g. Gunn 2003), thereby suggesting a link between rock art, visual perception (i.e. bodily experience), and Dreaming tracks.

To investigate whether such a relationship exists, a number of sites along a traditional travel route[1] were included in this analysis. Although the specific routes and nature of ancient Aboriginal travel are poorly understood at present, The Track is an ethnohistorically documented ceremonial and trade route used by the Darkinjung and Wonnarua peoples (Attenbrow et al. 2017, 182–83). Therefore, by operating under the assumption that The Track was a Dreaming track (Attenbrow et al. 2017; Moore 1981, 423), it can be expected that sites along it should also possess high visual affordances.

[1] The name of this travel route has been redacted in accordance with the wishes of Warren Taggart, an elder of the Wonnarua people. Hereafter it will be referred to as ‘The Track’

Table 1. Selection of historical and contemporary sources referring to the spatial qualities of Sydney-Hawkesbury engravings.

Author	Year	Quote	Place
HISTORICAL SOURCES			
Angas	1847	I refer to their carvings in outline, cut into the … flat rocks upon many of the headlands overlooking the water …	Sydney
Campbell	1899	The localities selected for these carvings … secure … a commanding view of the surrounding country and of sites of other carvings, and the ocean or some sheet of water.	Sydney-Hawkesbury region
CONTEMPORARY SOURCES			
Stanbury and Clegg	1990	Often, but not always, the engraving sites are prominently situated on outcrops which can be seen from afar.	Sydney
Taçon	2006	All five sites are located on particularly high platforms with expansive views in several directions. Their positions … appear to have been purposely selected on the basis of …views to other landmarks.	Wollemi National Park
Attenbrow	2010	Most rock engraving sites are on ridgetops and frequently in situations with panoramic views as at West Head and Bondi.	Sydney

Table 2. Selection of historical and contemporary sources referring to associations between engraved art and religious sites.

Author	**Year**	**Quote**	**Place**
		HISTORICAL SOURCES	
Angas	1847	At first the old woman objected, saying that such places [engravings] were all *koradji* ground, or 'priests' ground', and that she must not visit them …	Sydney
		CONTEMPORARY SOURCES	
Elkin	1949	The Aborigines of the north coast of New South Wales definitely had their most important sanctuaries on high places ... [It] seems reasonable to infer that the location of the petroglyphs in the Hawkesbury-Sydney [sic] region is of ritual and mythological significance.	Sydney-Hawkesbury region
Kelleher	2002	[Archaeologists] can expect a (highly probable) relationship between emotionally charged geography (e.g. dramatic, unusual, or distinctive features) and the associated material culture.	Blue Mountains National Park

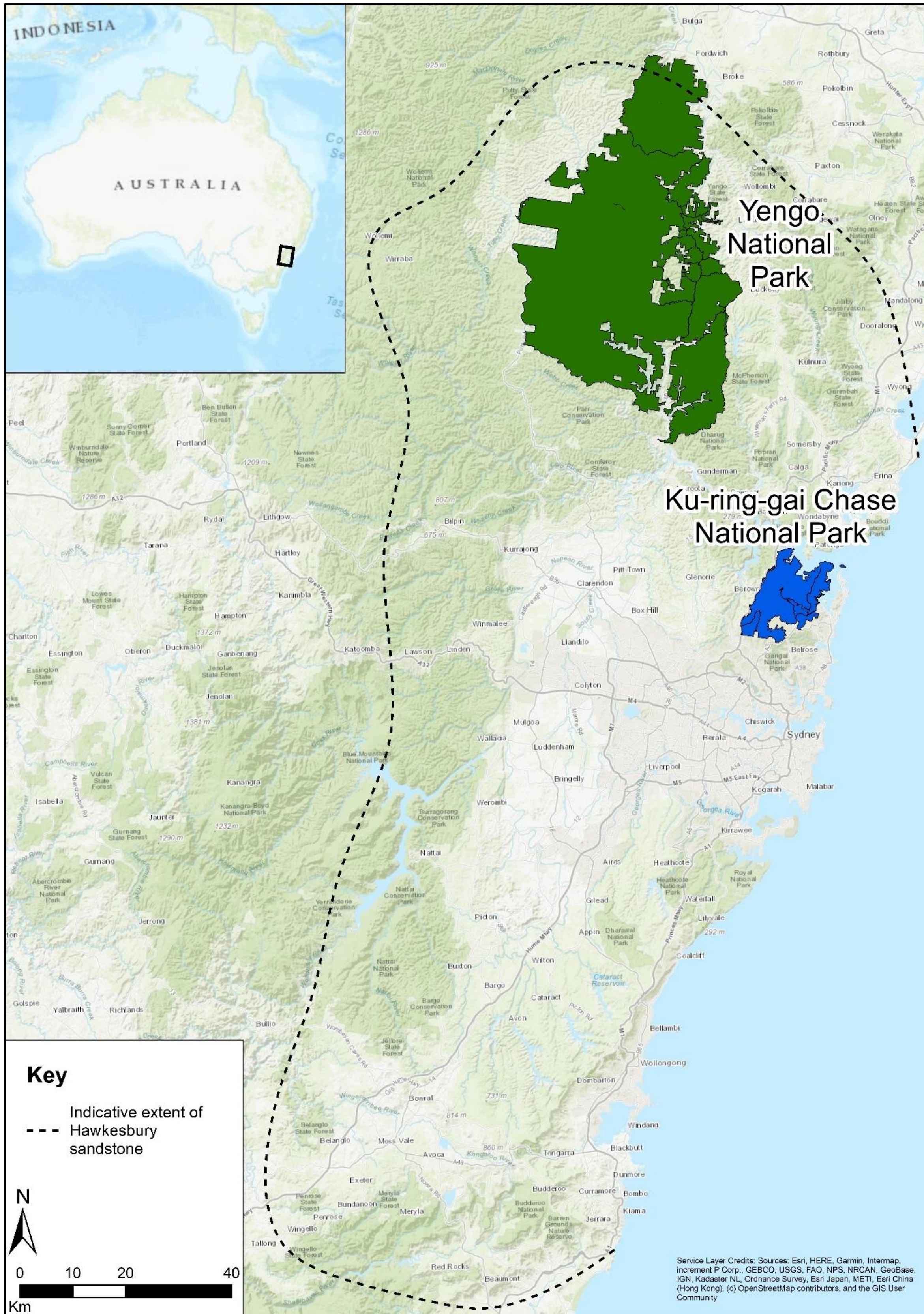

Figure 1. Indicative extent of Sydney-Hawkesbury engravings. Distribution follows extent of Hawkesbury sandstone based on 1:500,000 geological mapping.

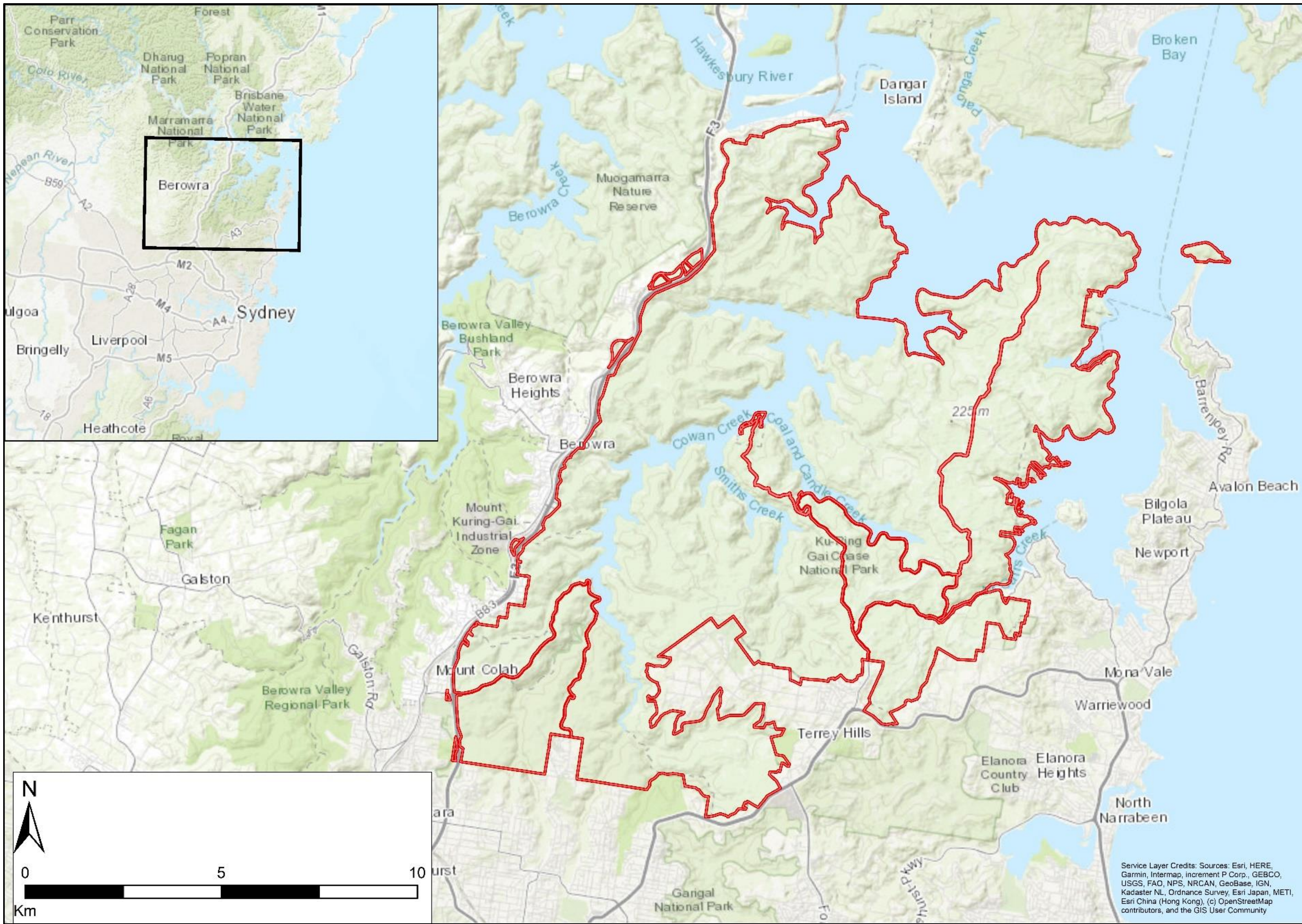

Figure 2. Ku-ring-gai Chase National Park.

Figure 3. Yengo National Park.

Research questions and aims

This thesis tests the hypothesis that visibility of the landscape was a factor in the placement of engraved art in the Sydney-Hawkesbury region.

To do this, three research questions will be answered:

1. ***Do engraving sites correlate with places affording extensive visibility?***

Dramatic, panoramic, awe-inspiring, and expansive views have been linked to engraved art in Sydney and to religious behaviour in general. Therefore, if engraved art bears a relationship to this spatial quality (i.e. extensive visibility), then engravings will be located in places with high levels of visibility relative to other places in the landscape.

2. ***Were places with dramatic or extensive views of the landscape involved with ceremonial activity?***

Some rare motifs in the Sydney Basin have been tied to ceremonial activity, and other research has pointed out that motif change is linked to certain activities. Therefore, if places with dramatic views were involved in ceremonial activity, then sites with rare motifs will have high visibility of the landscape.

3. ***Do engraving sites located along traditional travel routes possess better visibility compared to sites elsewhere?***

Aboriginal people would have been constantly moving through the landscape. People moved along Dreaming tracks; these travel routes are known to spatially correlate with rock art. Because of this, as well as the hypothesis that engraved art

was involved in the maintenance of regional social cohesion, engraving sites along travel routes are expected to have higher levels of visibility than sites elsewhere.

Three analyses will be undertaken to answer these questions. Analysis A aims to:

A1. Model the visual affordances of the landscapes in and surrounding Ku-ring-gai Chase and Yengo National Parks.

A2. Analyse the locations of engraving sites in the parks within each park's respective visual affordance model.

A3. Examine patterns of visual affordances found at engraving sites, and how they are similar to or different from broader visual affordance patterns seen in each national park.

Analysis B aims to:

B1. Examine patterns in visual affordance between common and rare motifs.

Analysis C aims to:

C1. Explore how these patterns may be similar to of different from sites along The Track and elsewhere in the national parks.

Assumptions

This thesis rests on several fundamental hypotheses regarding rock art in the Sydney-Hawkesbury region. The first is that engraved art in the region was produced within the last 5,000 years BP. Engraved art is difficult to date due to the lack of datable organic or stratigraphic material, and based on style and absolute dates obtained from two sites in the Sydney Basin (McDonald 2008; Taçon, Kelleher, and Brennan 2006), a maximum age bracket of 5,000 BP represents the finest temporal resolution currently available.

The second hypothesis is that the engraved and painted art components were produced contemporaneously. Research by McDonald (1999, 2000, 2008) has identified contemporaneous production of art in each context. This is important as it

suggests the art was produced for the execution of different goals. A third and related hypothesis, also developed by McDonald, is that the engraved art in this region functioned to signal group identity and maintain regional social cohesion.

A fourth hypothesis is that broad territorial areas existed in the Sydney Basin, although complex and dynamic social structures were in place, meaning people would have been affiliated with multiple locations across the region. The final hypothesis is that members of these social groups would have regularly traversed their own territories and others' for social, religious, and economic reasons.

Thesis structure

Research in this thesis is presented thus:

Chapter 2 introduces the framework of the thesis. It includes a discussion of theoretical perspectives of landscapes, sensory perception, rock art and GIS.

Chapters 3 and 4 describe and discuss the rock art of Australia and the Sydney-Hawkesbury region, respectively.

Chapter 5 presents the study areas and outlines their environmental, archaeological and social contexts.

Chapter 6 describes the methodology and results of the analysis.

Chapter 7 discusses the results and limitations of the analysis and interprets the findings in light of previous research.

Chapter 8 concludes and summarises the thesis.

CHAPTER 2. ROCK ART: LANDSCAPES, THE SENSES AND GIS

Definition

The term ‘rock art’ refers to images created by humans on hard rock surfaces. Rock art has been defined by Layton (1992, 1) as ‘deliberate communication through visual form’, while McDonald (2008, 43) defines ‘art’ as ‘all humanly made marks which occur in repeatable identifiable forms’. Rock art exists on every continent (besides Antarctica) and was produced from at least 30,000 years ago—probably earlier—until the present. Rock art exists in Australia wherever suitable rock surfaces are found (Morwood 2002, 37). The oldest reliable dates for pigment images are around 30,000 BP and come from northern and north-western Australia (Campbell et al. 1996; David et al. 2013). There is evidence for art production at 40,000 BP (O’Connor and Fankhauser 2001), and art production in Australia may have in fact begun tens of thousands of years earlier (Roberts, Jones, and Smith 1990).

Landscapes and rock art

Of the many themes present in the rock art literature, including (but by no means limited to) religion and ritual (Ross and Davidson 2006; Kelleher 2002), gender (McDonald 1992) and migration (Van Rooyen 2012), that of the landscape has found sustained and frequent exploration (and other themes are often explored this lens). Moreover, landscape approaches are more and more being recognised in the academic and professional spheres as the best way to investigate Aboriginal cultural

heritage. The permanence of rock in the landscape, mentioned above, is one reason for taking a landscape approach. Another is the fact that ancient Australians were mobile hunter-gatherers whose lives took place across a cultural landscape rather than in atomised locales (Flood 2004, 182). Landscape has long been recognised as socially constructed (Nash and Chippindale 2002, 1) and has been a prominent theme of archaeology for the best part of three decades. With origins in settlement archaeology, emphasising atomised *spaces*, landscape archaeology has come to a more nuanced view of the engagement of people within meaningful, culturally constructed *places*: 'Landscape is thus the entire surface over which people moved and within which they congregated…[it] has become a culturally meaningful resource through its routine occupancy' (Barrett 1999, 254).

Landscapes are thus actively constructed in a physical and mental sense. The landscape is 'the arena in which and through memory, identity, social order and transformation are constructed, played out, re-invented, and changed' (Knapp and Ashmore 1999, 10–13). Indeed, places are where human experience and consciousness unfolds. Place is 'part of us and we part of it. It mingles with our being, so much so that place and human being are enmeshed' (Grange 1985, 71).

Ingold (2010, 2011) embraces a more holistic approach and takes issue with the reduction of the landscape to a surface. He argues this moves things within the landscape (trees, hills, mountains etc.) to the limits of the material world whilst 'the space through which organisms live, move and perceive is rendered immaterial' (2005, 97). He asserts that landscape is not 'land,' it is not 'space,' nor is it 'nature'. For Ingold, the landscape is 'the world as it is known to those who dwell therein, who inhabit its places and journeys along the paths connecting them'; the landscape is not partible into smaller sections but is rather constituted by multiple centres: 'each

part of the landscape is an integral segment of it' (1993, 156). These insights provide a more dynamic and theoretically sound definition of 'landscape', although as Taçon (1999) notes, a truly accurate and holistic definition is likely to remain elusive.

Rock art is inseparable from the landscape of which it is a part (Bradley 1991; Chippindale and Nash 2004a, 11–12; Flood 2004; Rosenfeld 1997, 291). Analyses of the spatial patterning of rock art has led to an appreciation of its role in the control and socialisation of the landscape. Dibden (2019, 4) argues this happens by identifying and naming places with 'assigned cultural meanings…[helping to] structure a sociopolitical framework of space …and in this way serve to define and to articulate a shared identity by its legitimate users' (Rosenfeld 2002, 62; e.g. McNiven and Brady 2012).

Outside Australia, themes of the experiencing subject and the nature of landscapes as socially constructed are prominent (Nash and Chippindale 2002, 6; Tilley 1991; 2004; 2010; although see David 2002; David and Wilson 2002; Dibden 2019). In Europe and North America, landscape approaches have recently begun to go 'beyond the image' in explaining rock art. The work of Bradley (1991, 2005) was pioneering in his argument that despite being unable to recover the original meaning of rock art, we can attempt to identify 'some of the hidden structures that governed its creation and use' (2005, 154). Layton (1992, 2000) agrees with Bradley and argues that, whilst meaning may remain inaccessible, the fact that rock art makes ostensive references to the prehistoric world allows one to point to changes in behaviour. Assuming motif distribution throughout the landscape is non-random, then 'changes in context may be reasonably be referred to infer to changes in cultural significance' (Layton 2000, 52).

Sensory archaeology

The emergence of landscape phenomenology in the 1990s saw European landscapes subject to increasing research focusing on the relationship between landscapes and 'memory, meaning, personal experience and identity' (Brück 2005, 47; e.g. Gosden 2001; Thomas 1996). This in turn led to an archaeological appreciation of the role of the senses. The cultural nature of the senses, of which there may be as many as 21 (Durie 2005, 3), has long been a subject of interest within anthropology (Classen 1997; Classen, Howes, and Synnott 2003; Howes 2003; Ingold 2005; Stoller 1997). For instance, McClintock discusses the interesting premise that the practice of controlling body odour has its roots in Western colonialism, with British soap ads equating the state of smelling 'good' with the attainment of civilisation (2013, 223). As Gosden (2001, 165) states:

> Various cultures apprehend the world in different ways. Cultural forms educate the senses, privileging some over others and structuring the means by which we make sense of the world.

The application of this perspective to archaeology has been supported by Kus (1992, 172–73), who argues that social being is brought about and mediated by engagement with the material world; this engagement is facilitated and structured by our senses. The cultural nature of the senses is now recognised by archaeologists (e.g. Blake and Cross 2015; Hamilakis 2002; 2013; MacGregor 1999), anthropologists (e.g. Bille 2013) and geographers (e.g. Rodaway 1994). This recognition has facilitated an expansion of archaeological research on sensory perception. Notable examples include volumes edited by Hamilakis, Pluciennik and Tarlow (2002), Skeates and Day (2020) and Day (2013). Essays in these volumes

focus on the role of the senses in interesting and diverse contexts, including eating and sociality (Rowan 2020), emotion (Nugent 2020), volcanic activity (Holmberg 2013), warfare (Leonard and Breithoff 2020), medieval monastic spaces (Williams 2013) and imperial Roman blood sacrifice (Weddle 2013). The expansion of potential research agendas has raised new questions about the past. Rock art has been one arena in which the senses have seen growing research.

Rock art and the senses

The turn to the senses has shifted focus from representation to mediation (Howes 2019), meaning that any representational media (e.g. rock art) 'must be viewed…as part of the material apparatus through which' human experience is negotiated (Joyce 2005, 147). This shift has implications for rock art research. One of the first rock art researchers to recognise the sensory aspects of rock art was Ouzman (2001). He argued that archaeology's over-reliance on vision and visuality served to limit interpretive potential (2001, 238). He therefore focused on the auditory aspects of San rock art in southern Africa. Ouzman makes the case for sound and hearing being a major facet of the experience of San rock engravings; the rock art is not restricted to the image alone, but is part of a ritual process in which communities engage with upper and lower spirit worlds, and inhabit powerful places in the landscape which let them push through the membranous divider between worlds. Similar studies have been done in Australia (Taçon and Ouzman 2004) and northern Europe (Helskog 1999). These studies focus on issues beyond the image itself, which Jones (2017, 176) argues is critical in order for rock art theorists to profitably retool explanatory frameworks.

Exemplifying the shift away from representation and the image, many sensory studies examine how the senses may be implicated in the spatial distribution of rock art. As noted above, this general perspective has been advocated for by Bradley (1991, 11) and Layton (2000, 52). A large portion of this literature focuses on the role of hearing (e.g. Goldhahn 2002; Rainbird 2002). The acoustical properties of rock itself has been investigated by Boivin (2004) in the context of Neolithic Indian engravings, while the work of Díaz-Andreu et al. (2020), Díaz-Andreu et al. (2017) and Mattioli and Díaz-Andreu (2017) has furthered our understanding of the sensory context of Neolithic Spanish rock art.

The picture emerging from these studies is that artists often deliberately chose rockshelters with certain acoustical and auditory properties in which to paint. Data supporting this conclusion were obtained by considered instrumentational analyses (contra Goldhahn 2002 and Boivin 2003). Furthermore, the paper by Díaz-Andreu et al. (2017) was innovative in that it examined the role of both vision and hearing in the spatial patterning of Neolithic Spanish rock art. More interesting was the ability of this research to demonstrate changing attitudes towards vision and hearing—as they pertained to rock art—over time. This was done by comparing the sensory characteristics of art sites containing three distinct styles dated to different periods within the Neolithic. It was thereby clearly demonstrated that the earliest Neolithic artists in this region preferred rockshelters with certain acoustic qualities, followed by later artists' preference for visibility (Díaz-Andreu et al. 2017, 205). This has direct implications for the current thesis, as it provides grounds for the argument that style may be linked to changes in the sensory aspects of rock art.

Vision has also received much attention in sensory research on rock art. Bradley (1991) is an early example, as he argued British rock art to be implicated in the

visual control of the landscape. As mentioned earlier, this research inspired others to undertake similar enquiries. Purcell (2002), for instance, investigated the rock art of the Iveragh Peninsula in southwest Ireland. Based on spatial patterning of the art, he argued that each assemblage was intended to be viewed by different kinds of audience (2002, 90-91). A recent paper by Taçon et al. (2020) suggests visibility of rockshelters throughout the landscape was an important cultural factor in the location of Maliwawa rock art in Western Arnhem Land.

GIS (the emergence and archaeological take-up of which is discussed by Wheatley and Gillings 2002, 11–17) is now one of the most widespread tools used by archaeologists investigating spatial and sensory relationships with any kind of archaeological feature (Randle 2011; Van Dyke et al. 2016; for a recent Australian example see Law et al. 2017). In terms of visibility, Gillings (2009, 2015, 2017) Llobera (1996, 2003) and Wheatley (1995) are well-known GIS practitioners. During the 1990s, these researchers began engaging with concerns that GIS risked reducing landscape archaeology to an ecologically and technologically deterministic enterprise (Witcher 1999, 4; Hacıgüzeller 2012).

This view has been shown to be inaccurate. Llobera (1996, 613) demonstrated that environmental determinism comes not from any inherent quality of GIS but may rather result from the way archaeologists use and interpret information. He used Ingold’s (1993) definition of landscape which emphasises embodied practices (*habitus*; see Bourdieu 1977) occurring in *places* rather than *spaces* (Ingold 2011, 2015). He combined this definition of landscape with Gibson’s (1986) concept of ‘affordances’ (discussed below). Llobera made the case that affordances are ‘integral to the *habitus* of a group’ and went on to re-analyse the spatial structures of Wessex linear ditches originally studied by Bradley (1991). Llobera was able to

improve on Bradley's argument by using a variety of theoretically informed visibility and topographic analyses to conclude that the Wessex linear ditches were deliberately situated to organise the landscape in a certain way (Llobera 1996, 620).

Affordances

The concept of affordances was developed by ecological psychologist Gibson (1986). He outlined a theory of direct perception in which affordances play a major role. The concept of affordances is defined by Gibson thus: 'The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill' (1986, 119, emphasis in original). Another definition is offered by Ingold (Ingold 1993, 46): 'Affordances are properties of the real environment as directly perceived by an agent in the context of practical action.' Therefore, affordances are *possibilities* or *opportunities* for action.

There has been much debate within archaeology and adjacent disciplines regarding the exact nature of affordances. The most convincing model is outlined by Chemero (2003) who argues that affordances are relational (i.e. they depend on the interplay of the characteristics between an organism and the environment). Crucially for archaeology, 'Among the things we experience are relations between things, so relations are real, with the same status as the things that stand in relations' (Chemero 2003, 186). This line of reasoning therefore emphasises practical action and, for Chemero, opens the door for real affordances to be objectively investigated.

Framing any investigation involving affordances as 'objective' has its own shortcomings. In fact, affordances in general have come under criticism by some researchers, with Howes (2003) condemning the theory of affordances as

'contextless' and 'asocial'. Affordances do indeed risk 'reductive objectification' of past lived experiences (Gillings 2012, 608). The asociality of the concept of affordances and its risk of reductive objectification come from the broader literature of which the theory is a part.

The recent ontological turn views the theory of affordances as being part of a 'relational ontology'. Thinkers like Ingold (1993, 2005, 2010) and Latour (2005) exemplify the relational ontology in that they seek to deconstruct Western scientific perceptions of the world, which they argue serve to cloud understanding (Cipolla 2019, 616). As an alternative, these thinkers propose we look at *relations* between nature and culture (and question such binary opposites in the process). Ingold's (2005) reformulation of the perception of light, weather and the landscape embodies the tendency of relational ontology to explain how the world 'really' is; such a perspective does not derive from ethnographic data but comes from a belief that a relational ontology constitutes 'a better model of reality' (Cipolla 2019, 616). Although persuasive in their arguments, writers like Ingold and Latour risk appropriating Indigenous knowledge systems into Western institutional forms of discourse. To avoid this risk, a considered application of affordances follows, one which recognises that affordances as a concept are merely an investigative tool.

GIS, affordances and the senses

Rather than trying to 'objectively' map and study affordances (Chemero 2003, 193), the concept has instead been used fruitfully as a 'framing heuristic' in order to 'think out loud' about the relational situations being investigated (Gillings 2009, 2012, 608-609). The rationale behind this application of affordances follows from the fact that they are conditioned by the interplay between the physical world and people's past

experiences, knowledge and memory (Norman 1988, 54–80). Furthermore, because human experience of the world is always conditioned by complex, nuanced conventions and symbolic systems, many affordances must be actively learned (Hutchby 2001, 448–49). The complexity of affordances and the changing capacity of humans to recognise and engage with them makes mapping them a problematic exercise. Therefore, rather than targeting a particular aspect of visual perception (e.g. 'What can be seen from particular points in the landscape?') we may instead ask 'What is the relationship between a certain kind of behaviour and visual affordance?' Using affordances in this fashion helps avoid the 'reductive objectification' of experience.

This perspective owes much to studies by Gillings (1998, 2009, 2012, 2015, 2017), who derived inspiration from Llobera (1996, 2003). Gillings has applied the concept of affordances to research on ancient flood dynamics (1998) and to 'explore the inherent relationality of acts of looking and seeing' (Brughmans, van Garderen, and Gillings 2018, 14). He subverted criticisms of viewshed analyses (Aldenderfer and Maschner 1996, 2) through an innovative expansion of existing GIS visibility analysis methods. Rather than pushing the technology forward to arrive at 'some poorly defined tomorrow' (Gillings 2009, 335), Cumulative Viewshed Analysis (CVA, originally developed by Wheatley 1995) was applied in a novel way.

CVA allows for the cumulative visibility of a given location to be calculated. Lake et al. (1998) improved this method by including all locations (i.e. viewpoints) within the study area. Gillings combined CVA with a critical application of affordances to generate framing heuristics regarding the relationship between behaviour and the sensory qualities of megalithic monuments on Alderney, in the Channel Islands. This analysis threw doubt onto claims by Scarre (2002) that the megaliths of Brittany were

placed and structured according to ‘a prescriptive set of topographic or visual criteria’ (Gillings 2009, 352). This study and another by Gillings (2015) highlight the potential for GIS and affordances to together account for the dynamic, embodied nature of visibility. This evidence in large part rests on mapping exercises. As mapping also forms a large part of the current thesis, it is critical to examine what maps are and how they operate.

Mapping

The emergence of a more reflexive brand of archaeology in the 1990s facilitated a critical commentary on GIS, maps and mapping (see Gillings, Hacıgüzeller, and Lock 2019 for a more recent example). As an instrument of supposedly purely quantitative spatial analysis, GIS came to be seen as the epitome of distanced, objective modes of investigation (Aldred and Lucas 2019, 19). Concerns regarding GIS were frequently cast in oppositional terms between apparently ‘subjective’ post-processualism and quantitative or ‘processual’ GIS methodologies (e.g. Witcher 1999, 13). As discussed below, this is a false dichotomy; there is no reason to think GIS-based methods are incapable of drawing from a wide range of theoretical perspectives (Hegmon 2003).

Critiques which get at perhaps the most fundamental aspects of GIS and maps (and encompass those discussed above) come from feminist archaeologists (e.g. Kwan 2002a, 2002b; Tomášková 2015, 2019). A frequent critique of GIS and cartography is that of the ‘oppressive male gaze’ (Wickstead 2009, 250). Cartography and surveying are descended from colonial European practices; the ‘gaze’ of a conventional map is therefore characteristically male and western, and renders ‘women and colonised subjects “Other”’ (Wickstead 2009, 250).

The ability of maps to perform the ‘God-trick’, i.e. to see the world from everywhere and nowhere at once, is another frequent critique (Haraway 1991). What gives maps this kind of power? Hacigüzeller observes that the strong ‘faith’ in maps derives from the Western scientific tradition, in which the map epitomises ‘the ideal of perfect representation showing us the objective truth’ (2017, 155).

This observation relates to Johnson’s (2011) discussion of empiricism in archaeology. Empiricism was developed as a formal philosophy in the seventeenth century and held direct experience as the best way to investigate the natural world. What qualifies as ‘experience’? More precisely: *whose* experience can or should be relied on? Johnson argues that empiricism ‘rested on issues of trust born of membership of a particular [upper class, educated male] community…[therefore] *empiricism rests on assumption of cultural homogeneity* (2011, 770, emphasis in original). Johnson argues the development of empiricism in the seventeenth century served to transmute the philosophy into a wider cultural belief. This belief involves the unspoken assumption that data can be recorded, read, and mobilised without any theory brought to bear. It is reasonable to criticise the belief that maps constitute a perfect, neutral reflection of the world.

Scrutinization of surveying and mapping has fostered new approaches for critical archaeologists. The recognition that maps are a product of their creators’ subjectivities (Flexner 2009, 8) has led to practices of ‘critical’ or ‘alternative’ mapping. Alternative mappings acknowledge the fact that maps actively ‘translate’ and ‘order’ components of experience (Tomášková 2007, 277) and are relational or more-than-representational assemblages (Aldred and Lucas 2019). From this perspective, power relations and knowledge production processes relating to maps are disrupted in order to subvert post-processual critiques of mapping and GIS

methods. For instance, Hacigüzeller draws from gender theory to argue that maps are performances. A map is not a 'script' but, like gender, is 'real only to the extent that it is performed' (Butler 1988, 527, in Hacıgüzeller 2017, 151). Viewed this way, the 'epistemological myth' of the immutability and pure clarity of maps (Valdez-Tullett 2019, 178) is reduced. What needs to be stressed is the fact that maps emerge from the 'messiness' of interaction with places (Tomášková 2019, 88). They are therefore questionable (Valdez-Tullett 2019, 181-82) and have their own agency as a tool existing between the world and the person reading the map.

CHAPTER 3. ROCK ART IN AUSTRALIA

The age of Australian rock art

Determining the age of rock art is a perennial challenge for archaeologists, although radiometric dating methods have been applied with increasing frequency and success since the 1970s. Such techniques include Optically Stimulated Luminescence (OSL) (e.g. Roberts et al. 1997) Thermoluminescence (TL) (e.g. Roberts, Jones, and Smith 1990) and Accelerated Mass Spectrometry (AMS) radiocarbon (or ^{14}C) methods. Radiocarbon dating is the most common method of obtaining absolute dates for rock art in Australia (Langley and Taçon 2010, 70), due to its overall reliability and the ability of the technique to obtain dates from a small amount of organic material (Clottes 1997, 45; for a technical discussion of radiocarbon dating see Steelman and Rowe 2012).

The oldest absolute dates for pigment art in Australia range from a painted image at Nawarla Gabarnmang, Northern Territory, dated to 28,000 BP (David et al. 2013), to microscopic pigment remains lodged between accreted oxalate (i.e. mineral) crusts at Walkunder Arch at Chillagoe, Queensland, dated to approximately 31,000-33,000 BP (Campbell et al. 1996), and 42,800 ±1850 BP for a painted fragment of fallen shelter roof found at Carpenter’s Gap, Western Australia (O’Connor and Fankhauser 2001). Sediment containing engraved fragments at Ingaladdi, Northern Territory, have been radiocarbon dated to the early to middle Holocene, thereby indicating a minimum age of the art (Mulvaney 1975, 185). The oldest known engravings are located on the Burrup Peninsula and may be dated to anywhere between 27,000-60,000 BP (McDonald and Clayton 2016, 38). Earlier dates have been obtained from

organic material inferred to be related to the production of rock art. Roberts et al. (1990) were able to bracket an ochre crayon, striated from use, to between 61,000 ±13,000 BP and 45,000 ±9,000 BP by using thermoluminescence techniques. This finding may indicate the production of art at this time, although the lack of direct association to rock art reduces the strength of such an inference. However, cumulatively, there are reliable radiocarbon ages of rock art to indicate art production persisted from the Pleistocene (e.g. Watchman 1993) through to the Holocene (e.g. Huntley 2015) and into the contact period (e.g. McDonald 2008).

Radiometric dating techniques have enabled Australian rock art to be contextualised within assemblages elsewhere around the world. When comparing the age of Australian sites discussed above to dates obtained elsewhere, including Altamira, Spain (ranging from ~5,900–36,000 years BP) (García-Diez et al. 2013), Cosquer, France (~26,000–27,000 years BP) (Clottes 1997, 45-46), and Sulawesi, Indonesia (~40,000 years BP) (Oktaviana et al. 2016), some Australian sites are among the oldest in the world. Moreover, absolute dates of rock art provide valuable data used to inform key archaeological issues, including the emergence of symbolic behaviour (Bednarik 1992), the symbolic behaviour of Neanderthals (Rodríguez-Vidal et al. 2014), and the cognitive evolution and migration of ancient humans (Aubert, Brumm, and Taçon 2017).

Explanatory frameworks

Variation in time and space

Although difficult to establish chronological timeframes for rock art, its fixity in the land lends it a great deal of spatial certainty (Nash and Chippindale 2002, 9, 11). A large amount of research has been carried out on the geographic and chronological patterning of rock art in Sydney and around Australia (e.g. Franklin 2004; 2007; McDonald 2008; Morwood 2002). In large part, research builds on Maynard's (1976) Panaramitee model (or sequence). This model was proposed as a replacement for earlier ones (see McCarthy 1979), and describes three styles: the Panaramitee style, Simple Figurative styles, and Complex Figurative styles.

Franklin (2004, 4-5) provides a useful summary. The Panaramitee style was named after the type-site in South Australia and consists of pecked tracks and geometric designs. This style does not feature pigment art. It is found across the whole of Australia and purportedly exhibits continent-wide geographic uniformity. Simple Figurative styles (which is a group of several styles) consist of both pigment and engraved art in the form of solid or outline figurative motifs, with rare instances of decorative infill. Most Simple Figurative motifs are animal, human or object silhouettes, although some tracks are also present. Simple Figurative styles are present at the northern edges of Western Australia and the Northern Territory, and in the eastern parts of Queensland and New South Wales. Lastly, Complex Figurative styles (also a stylistic amalgam) are found only in northern and northwestern parts of Australia and can be distinguished from Simple Figurative by its greater sophistication, use of colour, infill and other decorative elements. The Panaramitee

model holds that over time each style replaced the earlier one, with stylistic heterogeneity increasing.

The Panaramitee has been argued to be late Pleistocene in age. The increasing availability of data has thrown doubt on the Panaramitee sequence (see Bednarik 2010). The biggest problem for Maynard's model comes from absolute dates obtained for art sites around Australia. Complex figurative art has been dated to around the Last Glacial Maximum (LGM, ~21,000 ±3,000 BP) in several places around Australia, including the Kimberley region, Western Australia (Roberts et al. 1997) and the Laura region, Queensland (Watchman 1993). On the other hand, absolute ages of Panaramitee engravings frequently indicate a Holocene antiquity (e.g. Smith, Watchman, and Ross 2009). Therefore, based on absolute dates alone, the supposed antiquity of the Panaramitee style and the recent nature of Simple and Complex Figurative cannot be upheld.

The Panaramitee model has also been undermined on stylistic grounds, with a degree of regional variability shown to exist (e.g. Franklin 2004; Rosenfeld 1991). Relative typologies have also been criticised at a broader level, as Rosenfeld & Smith (1997, 407) argue they do not form a closed system; that is, they are open to endless reformation and reinterpretation. Therefore, arguments in favour of both the supposed age and uniformity of the Panaramitee style, as well as arguments for increasing stylistic change and regionalisation over time, are inaccurate.

As such, in line with Franklin (2004, 84), the term 'Panaramitee' is not used to reference an Australia-wide artistic sequence. It is used rather to imply 'culture contact and continuity but not necessarily close similarity or uniformity' (Flood 1996, 179). Despite the issues discussed here, the Panaramitee model forms 'a useful

baseline for overviewing geographical and chronological change in Australian rock art (Franklin 2004, 4; Morwood 2002). Therefore, for simplicity, and with the above discussion in mind, the rock art discussed in this thesis will use the Panaramitee model to refer to general descriptive 'styles' of Australian rock art. No chronological or cultural implications derived from the model are adopted.

Rock art, territoriality and communication

The standard view of Australian rock art is that it bears a functional relationship to culture (Morwood 2002, 72). This framework examines rock art in light of environmental change and views style as a social strategy. Palaeoclimatic, demographic and archaeological data (Williams 2013; Williams et al. 2013, 2014; Ross 1985) indicate a rise in sea level and stabilisation around 8,000 years BP, coinciding with a population spike and continued population growth until the middle to late Holocene. Increased complexity in extractive technology also proliferated around this time (Hiscock 2008, 158). Territorial reorganisation, likely necessitated by rising sea levels, coupled with higher population densities and increasing use of adaptive risk-management strategies, have been argued to indicate greater regionalisation, with communication networks closing up during this period (e.g. Balme et al. 2009; Smith 1992).

Rock art shows evidence of undergoing changes (i.e. greater regionalisation) contemporaneous with these developments, as shown by stylistic analysis (e.g. David and Lourandos 1998; Franklin 2004; McDonald 1998, 2000; McDonald and Veth 2012). Importantly, the possibility of chronological intersections between Panaramitee, Simple Figurative and Complex Figurative has been used to justify functional interpretations of changes in style (Franklin 2004, 161). These studies

borrow from information exchange theory (Wobst 1977), which explains style as 'non-verbal communication through doing something in a certain way that communicates information about relative identity' (Weissner 1990, 107). Therefore, it is argued that by identifying style areas (e.g the Sydney-Hawkesbury or the Central Queensland Highlands) and analysing the levels of stylistic heterogeneity/homogeneity within and between style areas, it is possible to discern the type of information being communicated and the nature of the audience receiving information. This approach holds two central two implicit themes: movement and information flow. These themes are evident in research explaining differences in information communicated by engraved and pigment art, and the potential function of each medium in Sydney, the dynamics of mobility in the arid zone, and the colonisation of Australia as already noted. These studies focus on the *type,* rather than *content,* of communicated information. This is a useful approach (see Dibden 2019, 4).

Research on the art of Cape York, Queensland, provides an illustrative case study. David and Lourandos (1998, 208) observe that the oldest rock art of Cape York is characterised by region-wide geometric, linear, circular, pit and animal track designs, which has been dated (using radiocarbon on sediments to provide a minimal age) to the terminal Pleistocene/early Holocene. Regionalisation then increases with the appearance of painted motifs around 3,500 BP and 'full-blown regional traditions by 1,900 BP'. The appearance of new blade types and seed-grinding stones after 2,400 BP alongside increased intensity of rockshelter use and midden deposits after the mid-Holocene are used to argue that the changes in rock art are indicative of greater regionalisation during the middle to late Holocene. Besides Cape York, this pattern

has been observed in southeast Queensland (Morwood 1987) and West Arnhem Land (Layton 1992, 235).

The key to this perspective is the recognition that rock art is, as David and Lourandos (1998, 193) point out, ‘implicitly territorially-based’; they understand it to be a physical manifestation of people’s political links to places which stays fixed in place over long periods. This understanding of rock art squares with the socially constructed nature of landscapes (Nash and Chippindale 2002, 6–7). Importantly, the view taken by David and Lourandos is not the same as arguing that rock art *explicitly functioned* to sign territorial boundaries, a perspective which Rosenfeld (1997) argues is untenable. Rather, it may be one instance of ‘cultural conventions… [related to] the *dynamics* of relations between people and land’ (David and Lourandos 1998, 193-94, emphasis in original).

Research which historicises Dreaming myths and their relationship to rock art provides further support for the territoriality of rock art (David 2002). Arguments by Layton (2000) and Bradley (2003) are emulated in David’s investigation of shifting attitudes towards place, manifested in behavioural changes in Queensland. Ngarrabullgan, a mountain at the heart of Djungan country, forms a distinctive topographical and ecological ‘island’ within the surrounding landscape. The territoriality of rock art becomes clear in David’s conclusion that ‘the abandonment [of Ngarrabullgan] by the fourteenth century CE appears to have been mediated by the onset of a new system of signification that rendered the mountain inappropriate for habitation’ (2002, 46).

Another model, the ‘discontinuous Dreaming network’, perceives spatial variation in rock art to reflect regional variation in Dreaming tracks (Franklin 2004, 2007). Motifs

relevant to a particular Dreaming track or story were created in places associated with those stories, by people who lived in or had rights to those places (Franklin 2004, 160). Research on the spatial variation of rock art across Australia indicates more 'open' social networks in arid zones, particularly in central Australia. On one hand, motifs are generally more homogeneous there compared to more fertile regions; this is explained as a shared motif repertoire enabling people of different group identities to move across vast tracts of arid country (Franklin 2004, 2007, McDonald 1992, 2000, 2008). In this context, rock art served to cement social relationships in environmentally stressful conditions (Witter 2007). Additionally, the intersection of numerous Dreaming tracks in parts of central Australia is matched by a greater diversity of motif types present in those places. Conversely, motif repertoires are more heterogeneous at the edges of the continent (including the Sydney-Hawkesbury region). In this context, Franklin (2004) interprets rock art as a territorial marker along geographically more restricted Dreaming tracks.

Critiques of functionalism

Critical responses to functional explanations of rock art focus on the self-perpetuating, one-size fits all nature of information exchange theory (Jones 2017, 176). Two separate but related issues emerge here. Firstly, implicit ideas in Western thought about 'art' are imposed across a range of spatial and temporal rock art contexts, thereby limiting the potential for other facets of rock art to come to light. A salient criticism of current research in the Sydney-Hawkesbury region is that the relationship between rock art and other symbolic and/or stylistic behaviour in this region is underexplored. The geographical spread of the regional art style matches the extent of Hawkesbury sandstone; whether this regional style extended beyond in

the form of portable art or body art is unknown. If such a situation existed, it would have important ramifications for the functional and communicative explanations of Sydney-Hawkesbury rock art. Although a lack of available data may constrain this research, rock art and other forms of symbolic and stylistic behaviour are treated separately. This stems from Western ideas about art and is echoed in the emphasis on artistic audiences and messages. This emphasis stems from an assumption that rock art was created by an *artist,* to be *viewed;* the image takes precedence. In fact, the very label ‘rock art’, used to denote anthropogenic markings on rocks, is built on implicit Western ideas about art and carries potential biases with it.

The second issue is that functional explanations of rock art exist within and are inherited from an overarching human behavioural ecology (HBE)-dominated approach in Australian archaeology. This approach defines commercial archaeology, with certain landscape features (e.g. within 200m of water or presence of a sand dune system) dictating predictions about the presence of Aboriginal sites (Department of Climate Change, Energy and the Environment [DECCW; now Department of Planning, Industry and Environment (DPIE)] 2010). HBE examples from academic research include Crabtree, Bird and Bird (2019) and Moritz et al. (2020); these studies share a focus on the ecological constraints and determinants of prehistoric human behaviour in Australia. Behaviour is no doubt conditioned by climate, weather, access to resources, etc., but it cannot be explained in terms of environmental factors alone. Although ecology and culture are to some extent inseparable (and perhaps form an artificial binary in the first place), HBE-based approaches are so prevalent in Australian archaeology that other research directions are left unexplored.

Functional explanations of rock art have undoubtedly furthered our understanding of the archaeology of Australia. They have also, however, resulted in ‘an extraordinarily static social and ideational history’ of traditional Aboriginal life (Rosenfeld 1997, 290). Ancient people within this static history are reduced to ecologically constrained information transmitters and receivers, change is measured on a scale of several hundreds or thousands of years, and rock art is thought of almost exclusively in terms of the image. There is more to rock art than just the image.

CHAPTER 4. THE ROCK ART OF THE SYDNEY-HAWKESBURY REGION

Description

The first European recorders of the rock art of Sydney were the early colonists, who referred only to the engraved art and with little detail. They did not ask the local Aboriginal people about the meanings behind the images. Governor Phillip wrote in a letter on 15 May 1788:

> In Botany Bay, Port Jackson, and Broken Bay we frequently saw the figures of men, shields and fish roughly cut on the rocks; and on the top of a mountain I saw the figure of a man in the attitude they put themselves in when they are going to dance… (Phillip 1788, in Bladen, Britton, and Cook 1892)

W.D. Campbell and R.H. Mathews were two early recorders of the rock art of Sydney (e.g. Campbell 1899; Mathews 1896), with systematic recording beginning in the 1940s with the work of McCarthy (1946a, 1946b, 1947, 1961; McCarthy and Hansen 1960) and Sim (e.g. 1965). Early interpretations of the art were made by anthropologists using ethnographic data from other regions (e.g. Elkin 1949). Maynard (1976) was the first to subject rock art to quantitative analysis.

The rock art of the Sydney-Hawkesbury region is recognised as a distinctive regional style covering the extent of Hawkesbury sandstone (Figure 1). Several thousand art sites are known to exist in the region, with many more sites likely awaiting discovery. The extensive practice of rock art in dual media makes the art of this region unique; this is generally not the case for other places in Australia (McDonald 1998, 321). ‘Medium’ in this context may be defined thus:

> A shelter art site is defined as all the art which occurs within the dripline boundaries of a single sandstone rockshelter…[and an] engraving site is defined as all the art which is located across the limits of an open sandstone boulder/platform which is usually surrounded by a soil matrix and/or vegetation (McDonald 2008, 43).

Pigment art (pictographs) and engraved art (petroglyphs) exist in roughly equal numbers in this region. Pigment art is found only within rockshelters and engravings are found almost exclusively on open sandstone outcrops, although some have been found within rockshelters. Pigment art was created by the application of charcoal or coloured (usually white or red) pigments. Engraved art was created using a technique known as conjoined puncture, where the sandstone surface was impacted using a stone implement (Attenbrow and Kononenko 2017).

The rock art of the Sydney-Hawkesbury region fits Maynard's definition of a Simple Figurative style (1976, 200-201) and depicts a range of subject matter, including faunal (e.g. kangaroo, fish, eel), inanimate (e.g. boomerang) and anthropomorphic figures, in plan-view silhouette form and sometimes in profile (see Plate 1 to Plate 4). Motifs found in rockshelters are generally smaller than those found at engraving sites, with many of the latter depicting larger-than-life subject matter. The number of motifs at an engraving site may range from a single image up to 174 (McDonald 2008, 51). The labels 'simple' and 'figurative' derive from Maynard's observation that the motifs in this region appear to the modern observer as 'crudely naturalistic' (1976, 100).

'Culture heroes' form a significant motif class. They are usually anthropomorphic and sometimes therianthropic (i.e. exhibit some human and some animal traits) and exist in two forms. 'Biaime' motifs are shown in plan with their limbs spread out, and 'Daramulan' motifs are depicted fully or partially in profile (McDonald 1999, 156).

Biaime and Daramulan are recorded as being two principal Dreamtime deities in south-eastern Australia. Mathews (1905) relates that:

> 'Baiamē…[was]…the principal hero in the mythology of these people…[and] Dhurramulan was a sort of half brother or near relative of Baiamē's'. His name is made up from *dhurru*, thigh, and *mulan*, one side, the whole name meaning leg-on-one-side, as he is said to possess one leg only… (1905, 138-141)

Mathews also writes 'Dhurramulan caught a boy and…caused one of his front upper incisors to fall out. The tooth…[became] a sacred stone used in these ceremonies of initiation' (1905, 142).

The 'culture hero' label comes from McCarthy (1946a; 1961), who interpreted them as being of ritual importance based on earlier ethnographic analogy (e.g. Elkin 1949; Mathews 1896). Such an interpretation is tenuous, and the term 'culture hero' implies more cultural significance than may be warranted. However, these motifs stand out for their size (they are four times larger than other anthropomorphs), occasional therianthropic depictions, high degree of decorative infill, and evidence that over half have been subject to multiple engraving episodes, with extra features sometimes added (McDonald 1999, 156). Moreover, potential links between Daramulan and tooth-avulsion ceremonies documented in Sydney (Tench 1793) points to a heightened cultural significance of culture hero motifs. Lastly, the simple fact of their rarity also suggests this motif class had high importance for past Aboriginal people.

Plate 1. Anthropomorphic motif along the Basin Track in Ku-ring-gai Chase National Park.

Plate 2. Eel motifs along the Basin Track in Ku-ring-gai Chase National Park.

Plate 3. Anthropomorphic motif at AHIMS #45-3-0419 in Yengo National Park.

Plate 4. Small kangaroo/joey motif at AHIMS #45-3-0419 in Yengo National Park.

Dating

A comprehensive, secure chronology for the art of this region remains elusive, meaning a case for increasing heterogeneity over time is difficult to make. As mentioned above, available archaeological evidence thus far supports suggestions of a Holocene age for the rock art of the Sydney Basin. At present there have been only two absolute dates obtained from engraving sites in eastern New South Wales. Radiocarbon dates for a partially-buried sandstone slab at Mt Yengo, bearing Panaramitee engravings, indicated a minimum age of 2,800 BP for the art; McDonald, the original excavator, suggested the art may be as old as 5,000 to 6,000 years based on style (2008, 135). In the Blue Mountains west of Sydney, Taçon et al. (2006) dated oxalate crusts covering engravings within Emu Cave rockshelter. These dates indicated a minimum age of 2,000 BP for the art, although may be several thousand years older (Taçon et al. 2006, 235).

More Sydney Basin rockshelters and pigment art sites have been dated than engravings. Great Mackerel Rockshelter (located on the Lambert Peninsula, on the western shore of Pittwater) was radiocarbon dated by McDonald (1992) to as early as 3,670 ±150 BP. Occupation of this shelter continued into recent centuries, meaning the potential age of the art ranges over several thousand years. A similar maximum age was obtained at Angophora Reserve Rockshelter, Avalon Beach (~3km east of Ku-ring-gai Chase), which contains Simple Figurative charcoal and painted motifs, when McDonald and Ross (1990, 117) dated charcoal samples to around 2,000 BP. New methods like Portable X-ray Fluorescence (PXRF) have demonstrated a middle to late Holocene provenance for calcium ochres applied at Yengo 1 and Dingo & Horned Anthropomorph rockshelters (both located north of

Sydney in the coastal hinterland) (Huntley 2015). Despite strong evidence for human occupation of the Sydney Basin at ~36,000 BP (Williams et al. 2014), current evidence leads one to assume a middle to late Holocene age for all rock art in the region.

Explanatory frameworks

As elsewhere in Australia (see Chapter 3), rock art in the Sydney Basin is explained in terms of its function, and style is seen as a social strategy. Much research has been done by McDonald (1992, 1999, 2000, 2008), whose main goal has been to tie the function of rock art to its social context. Her work in this region may be summarised as follows. Analyses begin from the assumption that style operates to signal group identity. Therefore, given this body of art forms a distinct regional style (McCarthy 1979; Layton 1992), and that information exchange theory expects style to communicate information about identity (Weissner 1990, 105), determining the level of internal stylistic variation may lead to a more detailed understanding of rock art and the social systems of which it is a part.

McDonald (1994, 2000, 2008) undertook comparative statistical analyses of the levels of variation between the pigment and engraved components of the Sydney-Hawkesbury art assemblage. These analyses found, firstly, no evidence for the existence of internal style groupings (2000, 59-60); the status of the art as a regional style is therefore maintained. Secondly, the engraved component was found to be substantially more homogeneous than the pigment component, and this was not merely a reflection of the greater potential variability in the pigment component. Thirdly, there appears to be a stylistic ‘core’ located within Guringai country (NSW Central Coast centred around Broken Bay), with design contact between groups

evident to the north, west and south (2008, 291). An interesting manifestation of this pattern is the heavy concentration of regionally rare ‘culture hero’ motifs in this area (1994).

Finally, McDonald was able to demonstrate that the production of pigment and engraved art was contemporaneous. These findings led to the conclusion that art in each context was executed with different goals in mind (2000, 54). The shelter art is argued to have been involved in personal expressions of local group identity. On the other hand, it is argued that engraved art was involved in maintaining regional social cohesion and operated to signal identity at a broad level (1994, 145; 2008). In other words, engraved art allowed the multiple groups living in Sydney prior to 1788, who were likely not in frequent contact, to maintain geographically broad social ties, while the shelter art likely allowed groups to symbolically define themselves (2008, 340-41). Importantly, McDonald (2008, 348) found evidence linking periods of the highest occupational intensity with the production of shelter art. This supports the hypothesised function of rock art as symbolic communication in the context of heightened territoriality during the mid-Holocene.

However, the same issues inherent in functional explanations, discussed in Chapter 3, persist in this context. There is a need for a new approach to rock art research in Australia, one which accounts for the sensory experience of rock art.

CHAPTER 5. STUDY AREA

Ku-ring-gai Chase National Park and Yengo National Park

The study area is comprised of Ku-ring-gai Chase National Park and Yengo National Park, both located in New South Wales. Ku-ring-gai Chase National Park is situated within the Sydney Metropolitan Area, approximately 20 kilometres north of the centre Sydney (Figure 2). This park has an area of approximately 150km² and extends from the Hawkesbury River southwards to Garigal National Park (near North Wahroonga and St Ives Chase). It is bounded to the west by the Pacific Motorway and to the east by Pittwater, with the majority of Barrenjoey Head also part of the park. Ku-ring-gai Chase was established in 1894 and is listed on the Register of the National Estate, as it represents a remnant of Sydney's natural environment, has high aesthetic values as well as an abundance of Aboriginal sites (New South Wales National Parks and Wildlife Service [NPWS] 2014).

Yengo National Park is located to the far north-west of Sydney, within the Singleton Local Government Area, and has an area of approximately 1,543km² (Figure 3). The park lies to the south of the Hunter Valley with Putty State Forest adjacent to the west. It is bordered to the south by Parr State Conservation Area and Dharug National Park, with several other state forests and conservation areas adjacent to the east. It has been included in the Greater Blue Mountains World Heritage Area because of its high level of floral diversity (NPWS 2009, 14).

Ku-ring-gai Chase and Yengo belong to a group of ‘sandstone national parks’ within the Sydney Basin. Other parks in this group include the Wollemi, Blue Mountains, Brisbane Water and Dharug National Parks (NPWS 2009).

Ku-ring-gai Chase and Yengo National Parks present ideal contexts in which to situate this project. Advantages for selecting them include:

- Each park has been subject to relatively little modification. The early gazettal of Ku-ring-gai Chase has protected it from the rapid and continuing urban expansion of Sydney. Although Yengo was established relatively recently in 1988, it is in the Central Coast hinterland zone and as such has not yet been a focus of development. Although the landscape has no doubt changed over time, these parks represent two instances where changes are likely to have been the smallest. Differences in ancient visual affordances and those remaining observable today are therefore minimal compared to elsewhere.

- Each national park would have been frequented by Aboriginal people belonging to different groups. Because sensory perception is a culturally conditioned action, this may help illustrate any inter-group differences in the placement of engraved art.

- The nature of traditional Aboriginal travel is not understood well enough to create accurate models of movement. The presence of a documented Aboriginal travel route, The Track, within Yengo National Park allows for a level of investigation into movement and visual perception.

Environmental context

Ku-ring-gai Chase National Park is located in a marine zone on the Hornsby Plateau, a major geological feature of New South Wales. The Hornsby Plateau consists of sandstone ridges of the Narrabeen and Hawkesbury groups, and deeply incised steep valleys. The Sydney Basin formed during the Permian and Triassic periods (around 200-250 million years BP), and was a large freshwater lake during this time (New South Wales National Parks and Wildlife Service 2014). At the end of the Triassic, the Hornsby Plateau was thrust upwards, with vigorous erosion activity forming deep valleys in the surface of Ku-ring-gai Chase. Rising sea levels after the Last Glacial Maximum (LGM, approximately 21,000 years BP [Williams et al. 2018, 145]) flooded the deeper valleys, cut off Barrenjoey Headland and created the current geomorphology of the park.

The park ranges in altitude from Cowan Water to 228 m ASL at Willunga Trig on the Lambert Peninsula (NPWS 2014, 11). The dominant geological unit of the park is Hawkesbury sandstone (Department of Planning, Industry and Environment [DPIE] 2020) which forms most of the headlands, plateaus and hillslopes within the park. The soil landscapes present within the park (Hawkesbury, Lambert and Oxford Falls) can be broadly characterised as undulating rises along the shores of Pittwater and Cowan Water, to rugged, steep hills incised by narrow—in some areas, hanging—valleys in the interior of the park. Large sandstone outcrops are common in all areas (DPIE 2020). There are a number of hydrological features within and surrounding Ku-ring-gai Chase. Major watercourses include the Hawkesbury River, Pittwater and Cowan Water. Smaller watercourses include Smiths Creek, Yeomans Bay, Coal and Candle Creek, Salvation Creek and the Basin.

Ku-ring-gai Chase contains a diverse array of flora and fauna communities. Vegetation types range from dry heath communities to low eucalypt woodland and tall open forest (NPWS 2014, 15). Fauna species present in the park include various reptiles (e.g. heath monitor, leathery turtle and red-bellied black snake), birds (e.g. glossy black cockatoo and white-bellied sea eagle) and marsupials (e.g. ring-tailed possum, tiger quoll and long-nosed bandicoot) (NPWS 2014, 19-20).

Yengo National Park also lies on the Hornsby Plateau and underwent similar geological formation processes, although this park is in the hinterland zone. As elsewhere on the plateau, Narrabeen sandstone underlies Hawkesbury sandstone. Within Yengo, however, these rock strata tilt to the north, causing each rock type to outcrop in different topographical locations; in the south, Narrabeen sandstone is located only as thin outcrops at the base of slopes with Hawkesbury formations comprising the majority of topographic features. To the north, Hawkesbury sandstone exists only in remnant forms on top of the higher ridges, with Narrabeen formations comprising the dominant topographic strata (NPWS 2009, 10). Important watercourses within Yengo include the Macdonald River, Webbs Creek and Wollombi Brook.

Yengo National Park possesses a high level of biodiversity, due to its location within a ‘rain shadow’ at the convergence of three botanical provinces (NPWS 2009, 13). As a result, there are eleven broad vegetation communities within Yengo, including 43 eucalypt species throughout the park and a dry rainforest community on the top of Mt Yengo (NPWS 2009, 13-14). A large number of faunal species have been recorded as occurring within the park, including mammals (e.g. koalas, kangaroos and wombats), birds (glossy black cockatoo and powerful owl), reptiles (e.g. broad-headed snake) and amphibians (e.g. giant burrowing frog) (NPWS 2009, 17).

The physical characteristics of Ku-ring-gai Chase and Yengo result in similar patterns of visual affordance that are apparent when visiting each park. Vegetation and local relief generally act to restrict levels of visibility (Plate 5 and Plate 6). Sandstone outcrops tend to occur at higher elevations and preclude the presence of vegetation. As a result, these areas usually rise above the surrounding landscape and possess much better views than elsewhere (Plate 7 to Plate 9)—although this is not always the case (Plate 10). Physical reidentification of sites provided preliminary support to the hypothesis that visual perception influenced decisions about where to place engraved art.

Plate 5. Typical bushland in Ku-ring-gai Chase.

Plate 6. Typical bushland in Yengo.

Plate 7. The visual affordances of the Basin Track engraving site in Ku-ring-gai Chase.

Plate 8. The visual affordances at Frying Pan Rock in Yengo.

Plate 9. The visual affordances at Burragurra in Yengo. Mt Yengo can be seen in the distance.

Plate 10. Example of an engraving site in Yengo with comparatively low levels of visual affordance.

Archaeological context

The earliest reliable date for human presence in the Sydney Basin comes from a sand sheet (PT 12) at Pitt Town, northwest Sydney (Williams et al. 2014). Approximately 10,000 artefacts were recovered during this project. Optically-Stimulated Luminescence (OSL) ages taken from the sand deposit provide evidence for Aboriginal occupation beginning at ~36,000 BP and continuing until 8,000 BP (Williams et al. 2012, 2014). Elsewhere, Cranebrook Terrace has been dated to 40,000 BP (Nanson, Young, and Stockton 1987), although extensive debate surrounds this date (see Williams et al. 2012). Subsequent investigations in the same area have recovered artefacts dating to at least 10,000 BP (Williams et al. 2017).

Other sites in the region have been dated to the terminal Pleistocene and Holocene (e.g. Attenbrow 2007). However, most radiometric ages in Sydney are less than 5,000 years old (Attenbrow 2010). Existing radiometric age determinations have been interpreted as evidence for lower-density populations during the Pleistocene. Research by Williams (2013) and Williams et al. (2013, 2014, 2018) indicates that the Sydney Basin formed an ecological refuge during the Last Glacial Maximum (LGM), a period of increased aridity beginning ~30,000 BP and peaking around 23,000-18,000 BP. Excavations at Pitt Town demonstrate that the Hawkesbury River was variably but continuously occupied from the LGM through to the late Holocene (Williams et al. 2014). Although populations appear to have declined immediately at or following the LGM, it is likely that a regional population was still present. However, people were thinly dispersed across a number of ‘cryptic refugia’ (scattered areas containing ecological resources necessary for survival) employing high mobility and

point to point strategies during times of peak aridity (Williams et al. 2014). The results of excavations at PT 12 indicate Pleistocene populations were focused around coastal areas, with major riverine systems (like the Hawkesbury) providing access to hinterland regions. Population growth and rising sea levels during the Holocene then caused a demographic, economic and social restructuring (Extent Heritage 2020, 31; Williams 2018; Williams et al. 2014, 745). Overall this evidence indicates small, dispersed, and highly mobile populations persisting throughout the Pleistocene, with populations growing throughout the Holocene.

According to existing data, Ku-ring-gai Chase National Park has been inhabited since the middle to late Holocene. McDonald (1992) dated excavated charcoal samples from Great Mackerel Rockshelter. This date was interpreted as the earliest use of the shelter, probably as a sporadic hunting base (McDonald 1992, 48). Other dates obtained from Great Mackerel Rockshelter suggest intermittent occupation of the shelter continued until contact (~200 BP), with a peak in occupation intensity around 500 BP (McDonald 1992, 39). Radiocarbon dates derived from skeletal remains of a man found at Narrabeen (~6 km south-east of Ku-ring-gai Chase) indicate this individual died by spearing around 3700 BP (McDonald et al. 2007, 881–82).

Further south at Cammeray (~12 km south of Ku-ring-gai Chase), Attenbrow (unpublished data) dated an Aboriginal site using radiometric methods to ~5,800 BP (Attenbrow 2010, 18). Besides these radiometric ages, evidence for Aboriginal presence in Ku-ring-gai Chase comes from a vast number of registered Aboriginal sites, with shell middens being the predominant site type. There are also over 550 rock art sites present. It is unlikely that all sites present in the park have been discovered.

Radiocarbon ages derived from Yengo indicate occupation patterns conform to regional patterns discussed above, although occupation appears to have begun earlier than at Ku-ring-gai Chase. A rockshelter known as Yengo 1 underwent a program of radiocarbon dating following excavations by McDonald (2008), who obtained an earliest occupation date of around 6,000 BP. Occupation continued well into the last thousand years, with a peak in occupation intensity after 2000 BP (McDonald 2008, 98). Yengo 1 generally predates other sites in the Hunter region. From a broad perspective, there is evidence to suggest extensive yet intermittent use of the Hunter and Hawkesbury River valleys during the Pleistocene (McDonald 2008, 142).

Social context

Documentary knowledge of Sydney at 1788 relies on the unsystematic and often opportunistic observations of colonial writers. Our understanding of the social organisation of the region is therefore prone to inaccuracies. However, a general picture may be sketched. Sydney was home to four broad language groups in 1788: the Dharawal, Dharug, Guringai, and Darkinjung (following Capell 1970). It is likely that each of these were loosely confined to broad geographical areas (Capell 1970, 22). Within each language group there were several descent clans comprised of a number of smaller residence groups or bands (McDonald 1998, 324). The nature of relationships between clans and bands to country appear to have been different, with that of the former being religious and the latter being economic (Attenbrow 2010, 29). People belonging to a certain band would have had familial, marriage and/or totemic links with people belonging to other bands. Intergroup links and the organisation of different types of group means group boundaries would not

have been strongly demarcated. People were linked to different tracts of land via their immediate and extended relatives as well as through marriage, and bands were comprised of people with heterogeneous clan affiliation. The complex social dynamics of Aboriginal life in Sydney means that ‘connections and ceremonial obligations to particular areas’ would have been held by people from multiple local and non-local groups at any time (Irish 2017, 17–18).

There is ethnohistorical evidence for the existence of socio-geographical boundaries in Sydney. Irish describes an ‘affiliated coastal zone’, mapped based on historical analysis of the movement of documented Aboriginal people in the early colonial period. This zone covers the coastal strip of Sydney, roughly between Port Stephens and Shoalhaven, and extends inland to around Raymond Terrace south to Liverpool and then on to Burragorang. The potential existence of a coastal-inland divide is further suggested by the account from First Fleet officer Watkin Tench. He recorded an expedition northwest of Parramatta with Aboriginal guides Colebee and Ballederry. These men were from the Gadigal and Burramattagal clans (situated in the affiliated coastal zone), respectively. Tench records Colebee and Ballederry quickly found themselves in “country unknown”, and they described the people living there as “bad”. When the party finally reached the Hawkesbury River, Tench wrote that “[our] natives had evidently never seen this river before” (Tench 1793[1979], 225–26). Likewise, colonial officer David Collins wrote in 1798:

> The natives who live in the woods and on the margins of rivers are compelled to seek a different subsistence [to those on the coast], and are driven to a harder exercise of their abilities to procure it. This is evinced in the hazard and toll with which they ascend the tallest trees after the opossum and flying squirrel [gliders]. At the foot of Richmond Hill, I once found several places constructed expressly for the purpose of ensnaring animals or birds (Collins 1798).

Based on the above, it is apparent that a coastal-inland divide existed based on social identity and economic specialisation (as conditioned by environmental factors).

However, territorial boundaries were not well defined and an extensive web of social networks covering Sydney linked people to several places. Archaeological and ethnohistorical data demonstrates Aboriginal clans travelled throughout the Sydney Basin to meet with others to hunt, feast, fight, trade, hold ceremonies, arrange marriages and share information.

A case study centred on Mangrove Mountain (north of the Hawkesbury River) shows basalt ground-edge artefacts found in the NSW Central Coast were made from local sources and often carried around 60-100 km to their findspot. The greatest straight-line distance from a non-local source to findspot in the NSW Central Coast was 430 km; this was interpreted as evidence that movement in the fertile Sydney-Hawkesbury region was more restricted than in more arid inland areas (Attenbrow et al. 2017, 184). Ethnohistorical information shows people travelled to take part in the Bogong moth feasts (Flood 1980), to learn new songs (Backhouse 1843), to take part in large-scale hunting events (Barallier 1802), and to take advantage of irregular resource abundances, such as beached whales in Sydney (Tench 1793). Inter-clan relationships were not always friendly (White 1790, 288) and movement between clan estates was governed by a system of law encompassing social and territorial obligations (Godden Mackay Logan [GML] 2016, 28).

It is unclear exactly what role engraved art played in this context. Franklin (2004, 2007) interprets comparative levels of motif variation across Australia to suggest rock art acted as territorial markers in fertile, socially ‘restricted’ ‘closed’ regions like

Sydney. However, based on a more detailed, intra-region stylistic analysis, engravings were not strict territorial markers but facilitated social cohesion at a regional level (McDonald 1999, 2000, 2008). Finally, Aboriginal society at contact was not egalitarian, with colonists observing certain individuals (e.g. Bennelong), classes of individual (e.g. *karadjii*) and groups possessed greater rights or powers than others (Attenbrow 2010, 60; Collins 1798, 493–94; Tench 1793, 123–24).

According to this rough sketch of social organisation, Ku-ring-gai Chase National Park was part of the territory of the Guringai people at contact. Broken Bay was the northern extent of the Guringai estate, which ranged south to Port Jackson (Sydney Harbour) and west to the Lane Cove River (NPWS 2014, 21). The Guringai was comprised of many smaller groups, two of which inhabited what is now the park. The Garrigal people were located on the Lambert Peninsula and the Terramerragal were situated to the south near Turramurra (NPWS 2014, 21). Yengo National Park is part of the traditional lands of the Darkinjung people to the south and the Wonnarua people to the north (NPWS 2009, 28).

The Aboriginal population of the Sydney Basin was decimated by smallpox in the year following Governor Phillip's landing at Botany Bay in January 1788. At the beginning of March 1788, Phillip joined an expedition exploring Pittwater, Broken Bay and the mouth of the Hawkesbury River (Phillip 1788). This was the first of several expeditions to the area (Tench 1793, 152). By April of the same year, Tench wrote that 'An extraordinary calamity' had occurred within the local Aboriginal population (1793, 146). Governor Phillip wrote of the many Aboriginal people around Broken Bay 'who were found dead with the small pox … We have seen traces of it everywhere' (Phillip 1788, 308). Although devasted by disease, violence, and the colonial administration, the Aboriginal people of Sydney did not disappear. The few

survivors of the smallpox epidemic formed new bands from existing familial and marriage ties and maintained a presence in all areas of Sydney. Traditional practices continued amidst colonial Sydney, with Hyde Park used for ritual combat until Governor Macquarie abolished these contests in 1816 (Irish 2017, 28–29; Karskens 2010, 445). Despite the various strategies of dispossession and segregation levelled at Aboriginal people in the following decades, their presence in Sydney has continued into the 20th and 21st centuries.

CHAPTER 6. METHODOLOGY AND RESULTS

Introduction

The major objective of this project is to determine whether visibility of the landscape was a deciding factor in the placement of engraved art in the Sydney-Hawkesbury region. The key question, then, is what places in the landscape possess extensive visibility? To answer this, the ArcGIS Visibility tool was used to create affordance-viewshed maps of Ku-ring-gai Chase National Park and Yengo National Park. These maps were created using a 1 second Shuttle Radar Topography Mission (SRTM)-derived Digital Elevation Model (DEM). The locations of 85 engraving sites were obtained from Aboriginal Heritage Information Management System (AHIMS) site cards and plotted onto each map. The levels of visual affordance for each park were compared to those of engraving sites. Visual affordances were also examined for variation across two variables, including motif type and proximity to a documented travel route.

Background

GIS was applied to this analysis as it is a powerful data manipulation and visualisation tool. ArcMap 10.8 was the specific application of choice. Although free software is available (e.g. QGIS), the decision to use ArcGIS was based on its ability to handle complex operations using a diverse toolset unavailable elsewhere. Affordance-viewsheds formed the basis of this analysis as they represent a way to determine which places in the landscape offer extensive visibility of the surrounding land. By then mapping the locations of recorded engraving sites onto this model, we

can see whether particular sensory qualities of the landscape were targeted. The decision to use a 1 second SRTM-derived DEM was mainly influenced by the scale of analysis. Each cell of this DEM corresponds to a 30m x 25m square. This is a relatively coarse level of detail, although any loss of resolution is justified by the scale and time-intensive nature of the analysis (see Table 16). Another potential drawback is that it does not account for the effects of vegetation on visibility. However, this is justified from the point of view of an observer location because engraving sites only occur on open sandstone outcrops; by definition, these places are open spaces with no trees growing in them. Moreover, and again due to the scale of analysis, the presence or absence of vegetation has a negligible effect on visibility.

The Visibility tool is one of several tools of its kind available with ArcMap 10.8. The decision to use it over others was based on its ability to customise parameters (e.g. observer height) prior to calculating visual affordance. The visual affordances of Ku-ring-gai Chase and Yengo were examined to determine whether each engraving assemblage possesses higher average affordances than each park as a whole. As discussed earlier, the literature suggests a functional relationship between rock art, style and the senses may exist. Given this relationship, sites containing rare motifs may be expected to possess the most expansive views. To test this potential link, visual affordances were also analysed according to motif type (i.e. ‘common’ or ‘rare’). Movement was another variable investigated, as Aboriginal people were mobile and are thought to have frequently visited others’ territories; it is thought that rock art is a manifestation of the mapping of experience and landscape socialisation that would have happened as part of people’s engagement with the Dreaming.

Analysis A. General visual affordances

A 1 second SRTM DEM was obtained from Geoscience Australia for an area of land covering ~11,077km². This DEM was then clipped to an area of 469km² for Ku-ring-gai Chase and 3,681km² for Yengo (resulting in two separate elevation models). The original DEM was clipped beyond the extent of each park to avoid edge effects (Wheatley and Gillings 2002, 192). The resultant Ku-ring-gai Chase elevation model was again treated to exclude open bodies of water. This was done to focus only on the visual affordances of land surfaces; open waterways like Pittwater and Broken Bay were likely frequented when fishing and traveling, although the ratio of land to water was low enough to significantly alter the results. This was not done for the Yengo elevation model as there are no open bodies of water comparable to Broken Bay or Pittwater in that region.

A vector point coverage layer was then created from each raster DEM, resulting in 179,553 points in Ku-ring-gai Chase and 2,097,222 points in Yengo. These points correspond to the individual viewpoints included in the analysis (see Figure 4). Three new fields were added to the attributes table of each point coverage layer: OFFSETA, OFFSETB and RADIUS2. By adding these fields, viewshed parameters were able to be customised using ArcMap's Visibility tool. OFFSETA encodes the viewer height, OFFSETB does the same for the height of each observed point, and RADIUS2 represents the outer extent of the viewing distance. Numerical values corresponding to a measurement in metres were assigned to each new field (Table 3). The value of OFFSETB was assigned based on the average height of a prehistoric Aboriginal person living around Sydney (McDonald et al. 2007), while the

value of RADIUS2 is equivalent to the maximum distance at which a human being can visually identify 1m-wide targets (Ogburn 2006).

Setting up the analysis in this way does not reflect the reality of visual perception. However, this approach was necessitated by the limitations of ArcMap's Visibility tool and has been used effectively elsewhere (Gillings 2009). Importantly, this method equates to a cumulative viewshed (Lake et al. 1998) which allows for the analysis of visual affordances; using less than every point in the landscape would result in a binary viewshed. Visibility was then calculated with the above inputs and parameters in place. Due to the size of the Yengo elevation model, the affordance-viewshed map of this park had to be executed in four parts (see Table 16).

The point locations of engraving sites were then mapped onto each affordance-viewshed map.[2] As stated above, coordinate data were obtained from AHIMS site cards. Although the primary means of storing and retrieving coordinate data for archaeological sites in NSW, AHIMS coordinate data is liable to be inaccurate. This is mainly due to inconsistent recording standards and methods.

The values of each affordance-viewshed map were extracted to points and saved into a spreadsheet. The same was done for engraving site coordinate points. The average and median visual affordance values were calculated for each park and engraving assemblage. A biserial correlation test was performed on the data to determine whether change in dichotomous variable (i.e. engraving/non engraving) correlated with an increase in visibility.

[2] To conserve the privacy of engraving sites, their locations are not shown in this thesis.

Table 3. Standard affordance-viewshed calculation parameters.

Field	Value (m)
OFFSETA	0
OFFSETB	1.68
RADIUS2	6,880

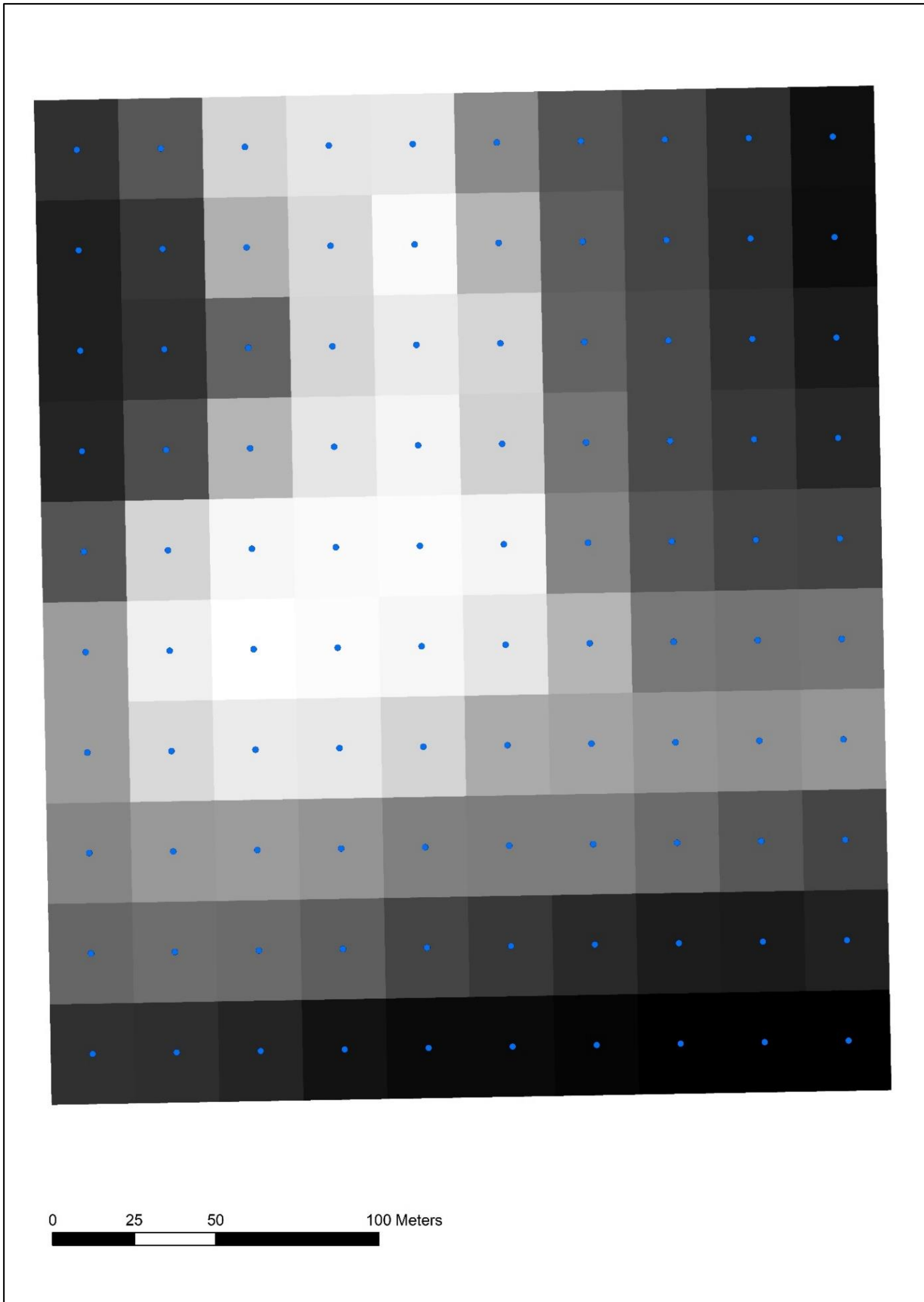

Figure 4. A sample 10x10 cell DEM area, showing viewpoints (blue dots) placed on each raster cell.

Results

Ku-ring-gai Chase

The visual affordances of Ku-ring-gai Chase National Park are displayed in Figure 5 and summarised in Table 4. As might be expected, areas of high visual affordance can be found along ridgelines and upper slopes. The average number of visible points when standing anywhere in Ku-ring-gai Chase National Park is 2,788, and the median number of visible points is 1,657. The average number of visible points when standing at an engraving site within this park is 3,849, and the median number of visible points is 1,966. Therefore, according to this affordance-viewshed, when standing anywhere in Ku-ring-gai Chase National Park the average amount of visible area is 2091km² and the median is 1,242.8km². When standing at an engraving site in this park, the average amount of visible land is 2886.8km² and the median is 1,474.5km².

Of the 32 engraving sites in Ku-ring-gai Chase National Park analysed, 16 (49%) sites have higher average visual affordances compared to the whole park 18 (55%) sites have visibility than the median level of this park as a whole.

Table 4. The visual affordances of Ku-ring-gai Chase National Park and engraving sites within it.

Ku-ring-gai Chase NP			**Engravings**		
	No. of visible points	*Visible area (km²)*		*No. of visible points*	*Visible area (km²)*
Average	2,788	2,091.0	*Average*	3,849	2,886.8
Median	1,657	1,242.8	*Median*	1,966	1,474.5

In a similar vein, results of the biserial correlation test indicate engraving sites in this park have a weak positive correlation with visibility; this correlation carries a borderline level of statistical significance (Table 5).

Table 5. Correlation (r) between engraving sites and visibility in Ku-ring-gai Chase.

r	0.008
p-value	0.05
Significance level alpha	0.05

Yengo

The visual affordances of Yengo National Park are displayed in Figure 6 and summarised in Table 6. Like Ku-ring-gai Chase, ridgelines and upper slopes in this park possess high visual affordances, as does Mt. Yengo. The average number of visible points when standing anywhere in Ku-ring-gai Chase National Park is 3,598, and the median number of visible points is 1,174. The average number of visible points when standing at an engraving site within this park is 11,262, and the median number of visible points is 5,616. Therefore, according to this affordance viewshed, when standing anywhere in Yengo National Park the average amount of visible area is 2,698.5km², and the median is 2,698.5km². When standing at an engraving site in this park, the average amount of visible land is 8,446.5km², and the median is 5,616km².

Of the 52 engraving sites in Yengo National Park analysed, 30 (57%) sites have higher average visual affordances compared to the whole park, and 47 (90%) sites have higher visibility than the median for this park as a whole.

Table 6. The visual affordances of Yengo National Park and engraving sites within it.

Yengo NP			**Engravings**		
	No. of visible points	*Visible area (km²)*		*No. of visible points*	*Visible area (km²)*
Average	3,598	2,698.5	*Average*	11,262	8,446.5
Median	1,174	880.5	*Median*	5,616	4,212.0

This is reflected in the results of the biserial correlation test. Like Ku-ring-gai Chase, engravings in Yengo have an overall weak positive correlation with visibility (Table 7).

Table 7. Correlation (r) between engraving sites and visibility in Yengo.

r	0.006
p-value	< 0.0001
Significance level alpha	0.05

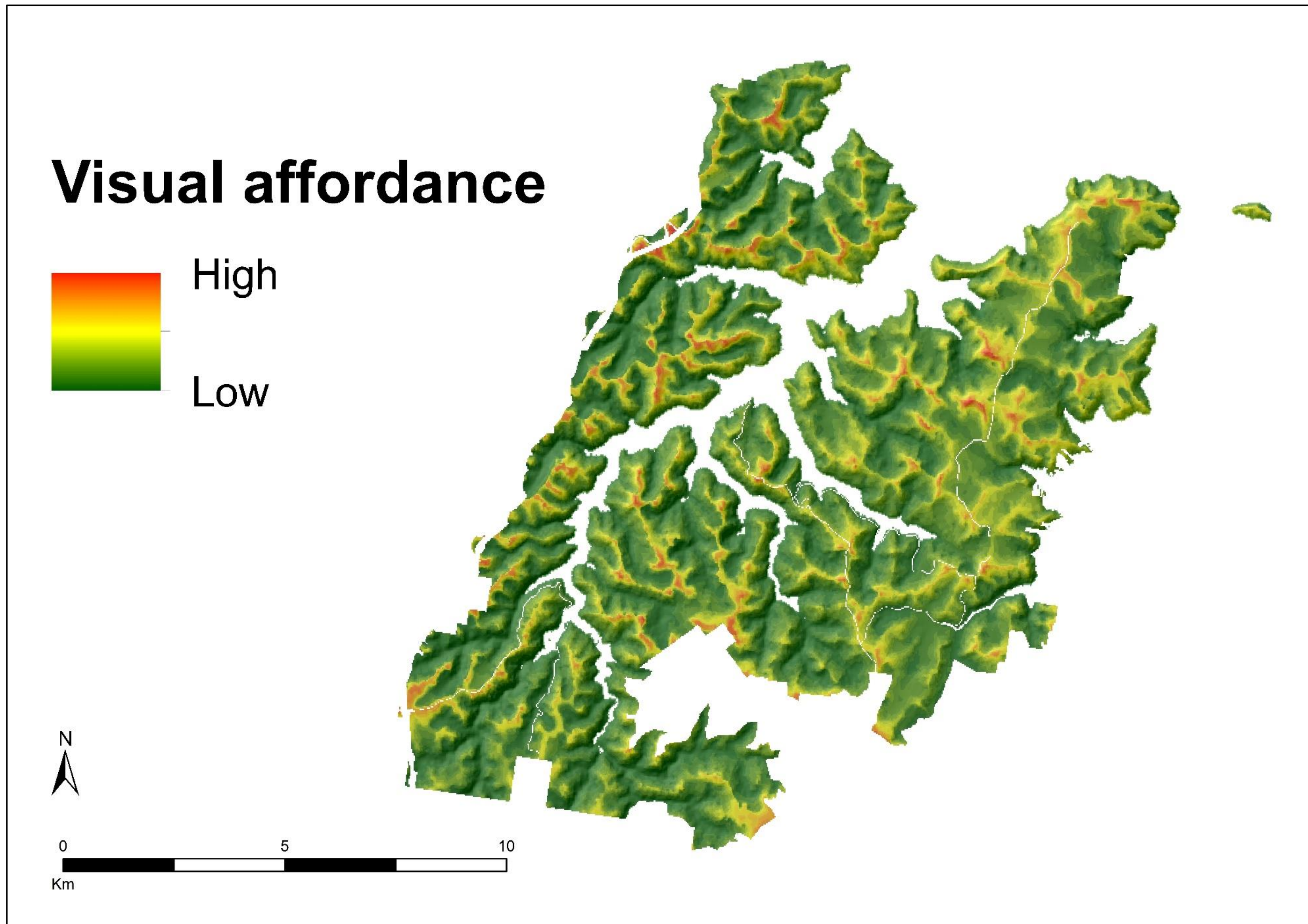

Figure 5. The visual affordances of Ku-ring-gai Chase National Park.

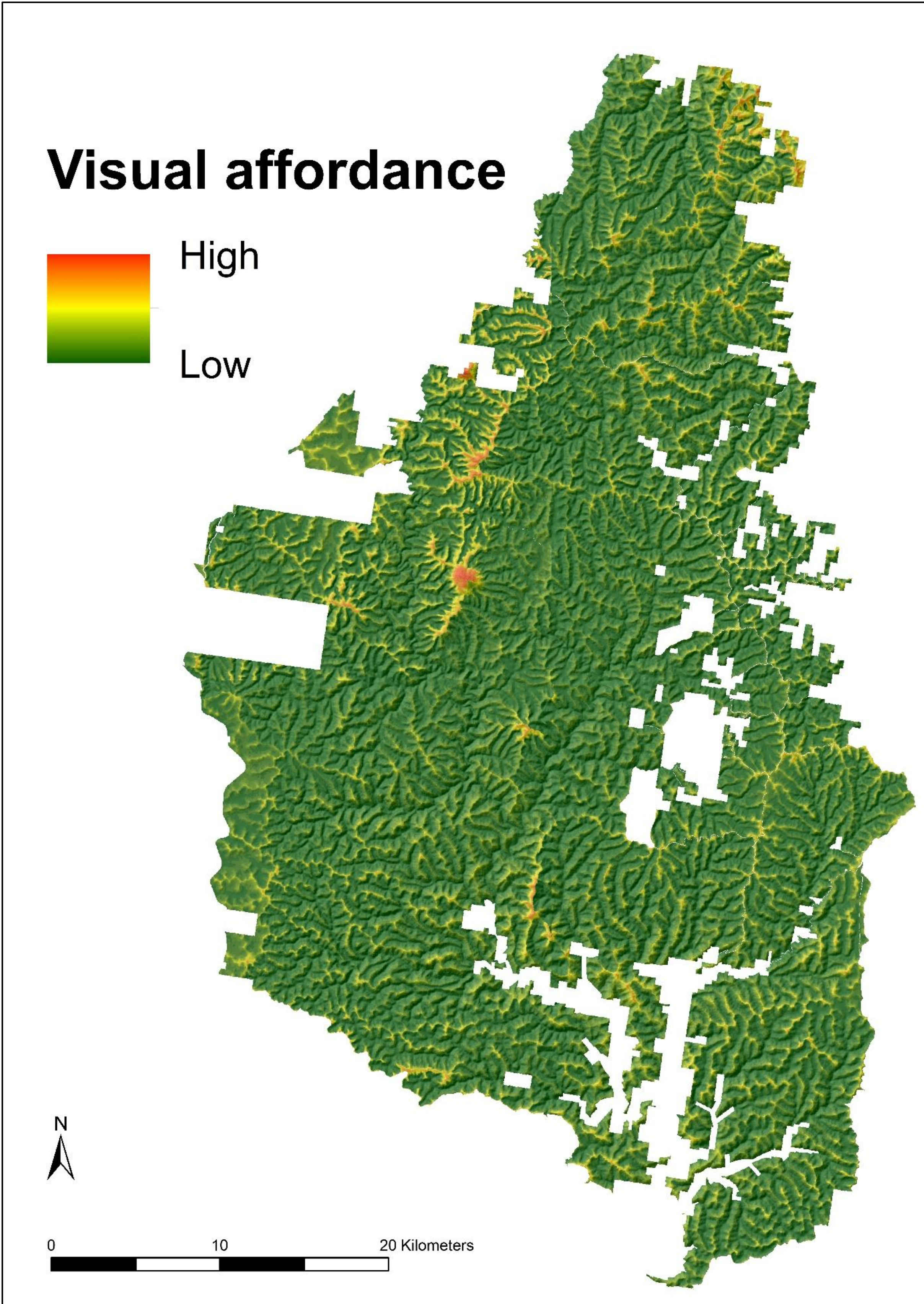

Figure 6. The visual affordances of Yengo National Park.

Analysis B. Style and visual affordance

To test the variation of visual affordances according to motif, engraving sites were grouped into classes corresponding to the rarity of motifs present. ‘Rarity’ was based on motif frequencies in the Sydney Basin reported by McDonald (2008).

The rare motifs included in Analysis B were culture hero motifs (see Chapter 4). As a brief reminder, culture heroes are occasionally depicted as therianthropes, are much larger and have more decorative infill than other motifs, are present at very few sites across the region, and many have been subject to more than one instance of engraving; a potential link between Daramulan and tooth-avulsion ceremonies also exists. In light of test implications formulated by Conkey (1980)—refined for Australian contexts by McDonald and Veth (2012)—to investigate aggregation dynamics, the above characteristics of culture heroes suggest this motif class is more significant than others. This is not to argue that sites with culture hero motifs were aggregation locales (although such arguments have been made for sites like Yengo 1, Devil’s Rock Maroota and Flat Rocks Ridge; see (McDonald 2008, 142, 286). Rather, the homogeneous nature of Sydney-Hawkesbury engraved motifs would suggest that special, restricted, or otherwise different activities (including the expression of special or restricted Dreaming stories and relationships) were undertaken where rare motifs are present.

This analysis was done in two parts. For the first part, each site was given a motif rarity score corresponding to the region-wide frequency of incidence of the rarest motif at each site (based on frequencies reported by McDonald 2008). A correlation test was then performed to determine whether low visibility is associated with low motif rarity.

For the second part of Analysis B, sites were grouped together based on overall motif rarity (according to motif types reported on AHIMS site cards). Given not all sites were physically re-identified, this classification was done in a conservative manner given the non-standardised nature of both motif identification and AHIMS recording.

Four groups of sites were analysed. Group 1 and Group 2 contained sites within Ku-ring-gai Chase:

- Group 1 consisted of 11 sites with common motifs, including anthropomorphic, macropod, emu, fish, whale and shield motifs.
- Group 2 consisted of 3 sites with culture hero motifs.

Group 3 and Group 4 contained sites within Yengo:

- Group 3 consisted of 17 sites with common motifs, including anthropomorphic, macropod, mundoe, kangaroo track and bird track motifs.
- Group 4 consisted of 3 sites with culture hero motifs.

This dataset was statistically compared in the same manner as in Analysis A (although a Pearson correlation test was used in this analysis).

Results

Ku-ring-gai Chase

As Table 8 shows, there was an overall weak negative correlation between visibility and motif rarity for sites in Ku-ring-gai Chase (see Table 19, Table 20 and Figure 8 in Appendix 2B).

Table 8. Correlation between visibility and motif rarity.

r	-0.199
p-value	0.284
Significance level alpha	0.05

Sites in Ku-ring-gai Chase with common motifs had a lower average level of visual affordance than those with rare motifs (see Table 5). The 11 sites containing common motifs (Group 1) had an average visual affordance level of 3,559, corresponding to a visible area of 2,669.3km². The 3 sites containing rare motifs (Group 2) had an average visual affordance level of 6,819, corresponding to a visible area of 5,114.3km².

Table 9. The visual affordances of sites in Ku-ring-gai Chase containing either common or rare motifs.

Group	Motif type	Average no. of visible points	Average visible area (km²)
1	Common	3,559	2,669.3
2	Rare	6,819	5,114.3

The lowest Group 2 visual affordance value was 3,771 visible points for a visible area of 2,828.3km² (at AHIMS #45-6-3277). The following sites in Group 1 had affordance levels higher than this:

- AHIMS #45-6-0441. This site had 14,252 visible points for a visible area of 10,689km².
- AHIMS #45-6-0772. This site had 7,387 visible points for a visible area of 5,540km².
- AHIMS #45-6-3269. This site had 4,224 visible points for a visible area of 3,168km².

Yengo

Similarly to Ku-ring-gai Chase, Table 10 shows there was an overall weak negative correlation between visibility and motif rarity for sites in Yengo (see Table 22, Table 23 and Figure 10 in Appendix 2B).

Table 10. Correlation between visibility and motif rarity in Yengo.

r	-0.145
p-value	0.349
Significance level alpha	0.05

Sites in Yengo with common motifs had a lower average level of visual affordance than those with rare motifs (see Table 6). The 17 sites containing common motifs (Group 3) had an average visual affordance level of 8,333, corresponding to a visible area of 6,249.8km². The 3 sites containing rare motifs (Group 4) had an average visual affordance level of 12,761, corresponding to a visible area of 9,570.8km².

Table 11. The visual affordances of sites in Yengo containing either rare or common motifs.

Group	Motif type	Average no. of visible points	Average visible area (km²)
3	Common	8,333	6,249.8
4	Rare	12,761	9,570.8

The lowest Group 4 visual affordance value was 9,466 visible points for a visible area of 7,099.5km² (at AHIMS #45-2-2595). The following sites in Group 3 had affordance levels higher than this:

- AHIMS #45-3-0325. This site had 19,274 visible points for a visible area of 14,455.5km².
- AHIMS #45-3-0837. This site had 43,009 visible points for a visible area of 32,256.8km².
- AHIMS #45-3-2070. This site had 19,040 visible points for a visible area of 14,280km².
- AHIMS #45-3-2225. This site had 15,539 visible points for a visible area of 11,654km².

Analysis B. Mobility and visual affordance

Landscape accessibility and the nature of traditional Aboriginal movement are likely to be important factors affecting the visual affordances of engraving sites. As such, a least-cost path (LCP) analysis originally formed part of this analysis. However, during preliminary research it was noted that fundamental uncertainty characterises current models of Aboriginal mobility. The most decisive objection to current understandings relates to scant primary evidence documenting actual travel routes or landforms favoured for travel. This means any LCP input parameters based on current research may result in potentially misleading models of mobility. This is demonstrated in Figure 7, which displays the result of a least-cost path analysis using the approximate start and end points of The Track. The resultant path differs drastically to the actual route of The Track (which is not published here in accordance with the wishes of Warren Taggart, an elder of the Wonnarua people).

The possibilities for analysing the relationship between movement and visibility were restricted for this reason. To test this relationship and avoid problems sketched above, the variation of visual affordances according to proximity to a known travel route (The Track) was tested in two ways.

Firstly, distance from each site to The Track was calculated and correlation test was then performed to see whether visibility had an association with proximity to the track. Secondly, sites within 250m of The Track (Group A) were compared to other sites in Yengo (Group B). One site located 260m away from the track was included in Group A based on size of the site and proximity to several others closer to The Track. The same method of statistically comparing the dataset used in the previous two analyses was again followed.

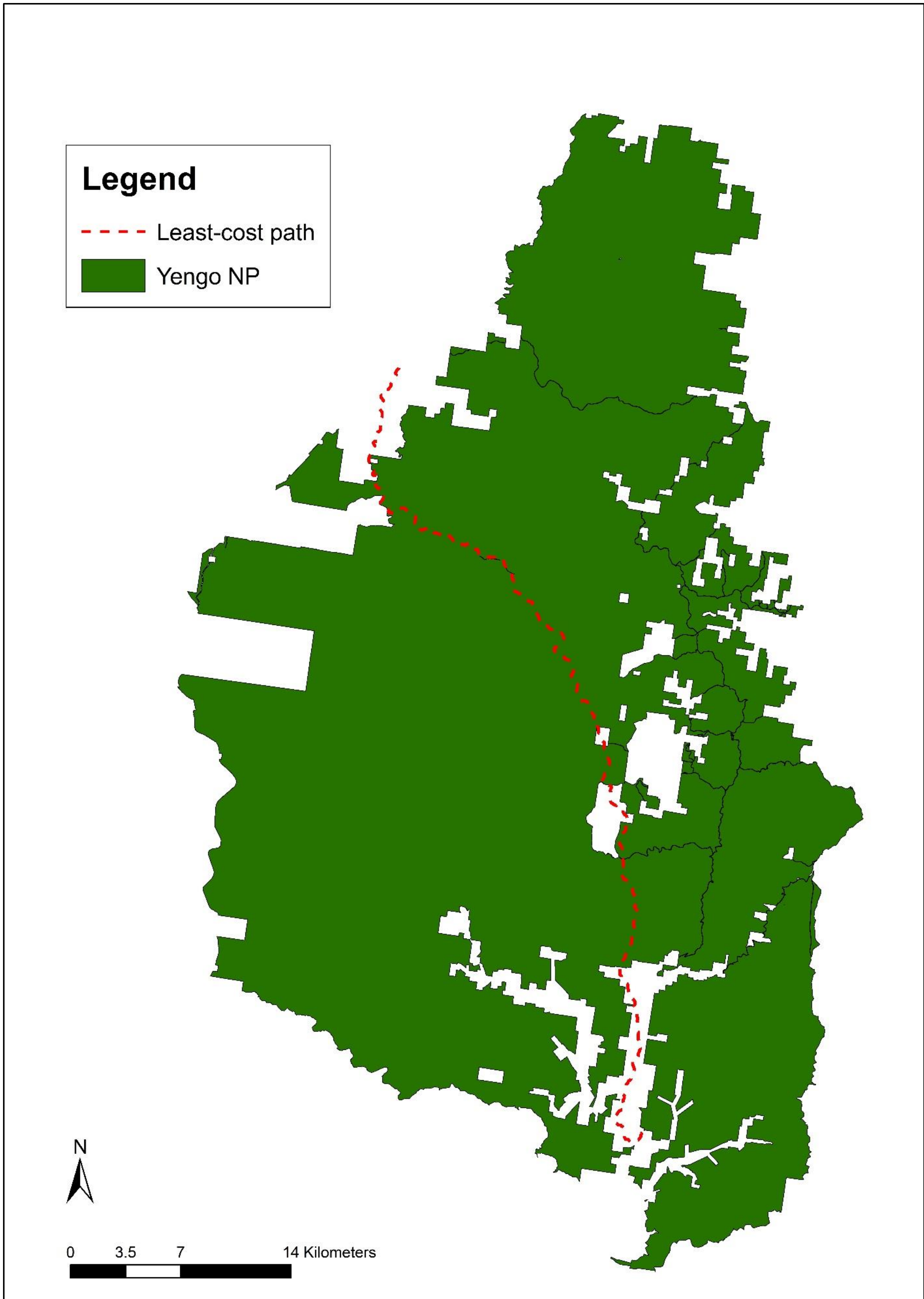

Figure 7. The result of a least-cost path analysis using the approximate start and end points of The Track. The LCP and actual route of The Track differ significantly.

Results

The results of Analysis C show that, overall, visibility has a weak negative correlation to distance from The Track (Table 12; see also Figure 9 in Appendix 2B).

Table 12. Correlation (r) of visibility to distance from The Track.

r	-0.274
p-value	0.072
Significance level alpha	0.05

The visual affordances of sites within 250m of The Track (Group A) and elsewhere (Group B) are summarised in Table 7. The 15 sites in Group A had an average visual affordance level of 20,982, corresponding to a visible area of 15,736.7km². The median visual affordance value of Group A was 15,539, corresponding to a median visible area of 11,654km². Sites in Group B had an average visual affordance level of 7,322, corresponding to a visible area of 5,491.3km². The median visual affordance value of this group was 3,561, corresponding to a median visible area of 2,670.8km².

Table 13. The visual affordances of sites within 250m of The Track (Group A) and those elsewhere (Group B).

Group A			**Group B**		
	No. of visible points	*Visible area (km²)*		*No. of visible points*	*Visible area (km²)*
Average	20,982	15,736.7	*Average*	7,322	5,491.3
Median	15,539	11,654.0	*Median*	3,561	2,670.8

Three sites in Group A had an affordance value lower than the Group B average, including:

- AHIMS #45-3-0013. This site had 1,971 visible points for a visible area of 1,478km².
- AHIMS #45-3-0408. This site had 1,582 visible points for a visible area of 1,1865.5km².
- AHIMS #45-3-3785. This site had 3074 visible points for a visible area of 2,305.5km².

CHAPTER 7. DISCUSSION AND INTERPRETATION

Answers to research questions

1. Do engraving sites correlate with places affording extensive visibility?

The results of Analysis A indicate there is an overall weak positive correlation between engraving sites and visibility in Ku-ring-gai Chase National Park and Yengo National Park. Over half the sites in Ku-ring-gai Chase have a higher level of visibility than the median visibility value of that park; this is also the case for the majority (90%) of sites in Yengo. Although correlation tests indicate a weak association between engravings and visibility, this is interpreted as a significant result given the visibility histograms of both parks are skewed to the right. Despite there being many more places in each national park affording relatively lower levels of visibility, most engraving sites are situated in places with high (i.e. above average and above median) visibility of the landscape.

2. Does motif rarity correlate with visibility?

The results of Analysis B indicate motif rarity has a weak correlation with visibility. The p-value obtained in correlation tests for both Ku-ring-gai and Yengo suggest motif rarity is one of several factors influencing visibility. However, results of a comparison between rare and common motifs in Groups 1 and 2 (situated in Ku-ring-gai Chase) and Groups 3 and 4 (situated in Yengo) showed that sites in Ku-ring-gai

Chase containing rare motifs generally had higher average visual affordances than sites containing common motifs. Likewise, sites in Yengo containing rare motifs generally had higher average visual affordances than sites containing common motifs. Reflecting the weak association of visibility and motif rarity, some sites in both parks containing common motifs had higher levels of visual affordance than sites with rare motifs. Nonetheless, visibility at culture hero sites was generally higher than at other sites. This trend was marginally more pronounced in Yengo.

3. ***Do engraving sites located along traditional travel routes possess better visibility compared to sites elsewhere?***

The results of Analysis C indicate that proximity to The Track is weakly correlated with visibility. Like in Analysis B, the p-value obtained in this analysis reflects the likelihood that other factors explain the association of these variables. Despite this weak correlation, sites located within 250m of The Track had emphatically higher average and median levels of visual affordance than the average and median visual affordance of Yengo National Park. Furthermore, six of the seven sites with the highest levels of visual affordance in Yengo are situated along The Track.

Interestingly, two sites that were part of Group 3 in Analysis B (i.e. contained common motifs) which exhibited higher levels of visual affordance than sites with rare motifs in Yengo were also part of Analysis C. The fact that almost all sites with the highest levels of visibility in Yengo are located along The Track is also significant. Although a small sample size, this would suggest that there is a closer relationship to mobility and vision than between motif and vision.

Based on the results of Analysis C, engraving sites along traditional travel routes have much better visibility of the landscape than sites located elsewhere. However, the results of this analysis suggest the relationship between mobility, vision and engraved art is not a strong one; despite visibility at sites along The Track generally being very high, sites outside the 250m range cannot reliably be expected to have low visibility. This is unsurprising given the likelihood that undocumented traditional travel routes exist in Yengo National Park.

Discussion

Based on the results of these analyses, visibility of the landscape was a factor influencing the location of engraved art, although its status as a prescriptive spatial determinant is difficult to substantiate. The results of Analysis B are interpreted as indicating sites with rare motifs were generally located in places with relatively better views of the landscape. Interestingly, these results support a link between ceremonial activity and visual perception. Assuming culture hero (or Biaime/Daramulan) motifs were involved in ceremonial activity such as tooth-avulsion ceremonies (as suggested by Elkin 1949; McCarthy 1961), then the generally high levels of visibility at culture hero sites suggests that high visibility was targeted for fostering feelings of awe during ceremonial activity. This interpretation is supported by research on religious sites in the Blue Mountains west of Sydney (Kelleher 2002).

However, Analysis B indicated only low levels of statistical significance for the relationship between motif rarity and visibility. This is likely an artefact of the method

used to rate rarity. Because it was assessed according to the rarest motif present at any site, rarity in terms of motif co-presence was not captured. The small sample size of sites with culture hero motifs (n=3 for both Ku-ring-gai Chase and Yengo) is also considered to have affected the analysis, although the inherent rarity of such motifs makes this issue unavoidable. The weak correlation between motif rarity and visibility was also a result of several sites with common motifs having higher visual affordance levels than sites with rare ones.

The weak correlation and low statistical significance observed in Analysis B do not reject the hypothesis that visual perception was involved in ceremonial activity. The fact that some sites with common motifs had higher visibility than sites with rare ones merely indicates not every complexity of the relationship between vision and behaviour was captured in this thesis. Moreover, this does not mean places with high visibility were not specifically targeted for the production of rare motifs. Culture hero sites were in fact generally located in places with high visibility relative to other sites. As discussed in Chapter 3, environmental factors condition but do not dictate behaviour. Therefore, in the context of engraved art and visibility, the important thing is whether a place was *perceived* to have good visibility by people in ancient Sydney.

Movement has emerged as an important theme related to visibility. Motif rarity was slightly higher at sites within 250m of The Track. Likewise, visibility levels were emphatically higher at these sites, and distance from this travel route was negatively (although weakly) correlated with visibility. Finally, six of the seven sites with the highest visual affordances in Yengo are situated along this route. Taken together, these results suggest that engraved art along travel routes bears some heightened significance, and high visibility of the landscape was a desirable factor when creating art in this context.

The low levels of statistical significance found in almost all correlation tests are interpreted as indicating visibility was likely not the only factor in the placement of engraved art, nor would it always have been the most important one. This is true at each scale of analysis. Generally, engraving locations possess high visibility of the landscape, although visibility is not a strict spatial determinant. Visibility at culture hero sites are generally better than at other sites, although sites with common motifs sometimes possess higher levels of visibility. This likely reflects the effect of motif co-presence on visibility. Finally, visibility at sites along The Track is emphatically higher than at sites elsewhere in Yengo. The relationship between visibility and engraved art is most pronounced at these sites, although again, some other sites had comparable levels of visibility. Nonetheless, this is taken to suggest that movement is a theme intricately linked to visibility.

Limitations

A lack of temporal resolution presents the biggest limitation to this thesis. This is partly to do with the fundamental difficulty of obtaining absolute ages for engraved rock art. Not only is it challenging to date the creation of the art, but the nature of sandstone outcrops on which engravings occur precludes the deposition of datable stratigraphy. A region-wide maximum age of around 5,000 BP has been suggested, and absolute dates derived from engravings in the Sydney Basin—of which there are only two—indicate an age of around 2,000-2,800 BP (McDonald 2008; Taçon, Kelleher, and Brennan 2006). In both instances the art may be several thousand years older based on stylistic considerations. If the age of the art discussed in this thesis is assessed based only on these absolute dates, then almost three thousand years of Aboriginal history becomes static and monolithic.

In the current research context, attitudes about visual perception and meanings attached to dramatic views would have been diverse and changed over time. This diversity disappears with the absence of datable material at engraving sites. However, the effects of this issue are mitigated by the fact that rock art remains fixed wherever it was first produced. Therefore, we can be reasonably confident that the spatial qualities of engraved art reflect one facet of how ancient people engaged with the world via visual perception.

Another limitation relates to the classification of common and rare motifs. Rarity was assessed based on region-wide frequency of occurrence, and motifs at each site were identified from AHIMS site card descriptions. Motif classification is an inherently subjective exercise and the adoption of more objective recording conventions (e.g. Officer 1984) is not evident in AHIMS site cards. This is considered to have affected the outcome of the analyses discussed above. Future research would benefit from a comprehensive program of site reidentification which adopts motif classification conventions like Officer's. The recording of motif co-presence frequencies would also be of value, as it may provide a more nuanced picture of motif rarity. The inclusion of as many sites with culture hero motifs as possible would be another step forward.

A third limitation relates to uncertainty regarding the exact route of The Track. It was mapped in this thesis according to previous research by Moore (1981) and conventional knowledge about its route through Yengo National Park. The general location of the track can be identified with reasonable confidence, although the existence of branching routes and the paths they took is less certain. A related and more fundamental issue pertains to the nature of traditional Aboriginal mobility itself. Current research supports a model of extensive social networks linking individuals and groups to multiple places throughout the Sydney Basin. However, knowledge of

the paths people took and the landforms they followed is, at present, insufficient for further research into the relationship between visibility and engraved art. This is a knowledge gap which, if filled, would progress research in multiple arenas.

Engraved art, visual perception, and the Dreaming

This thesis exists within a body of literature that investigates sensory perception to gain a deeper understanding of human behaviour (e.g. Bille 2013; Bradley 2005; Chippindale and Nash 2004b; Howes 1991; MacGregor 1999; Pillatt 2012; Rifkin 2009). It has focused on the relationship between visual perception, engraved art, and the landscape. Landscapes are actively constructed—both physically and mentally—and are the arena in which experience unfolds (Knapp and Ashmore 1999, 10–13). Places constitute landscapes and are inextricably linked with being (Grange 1985, 71). Therefore, this thesis has demonstrated how visual perception may be implicated in the production and experience of place. It has also shown that Australian rock art need not be explained solely in terms of the image (see also Dibden 2019; Taçon and Ouzman 2004). Some have argued a landscape perspective allows one to identify 'some of the hidden structures that governed…[the] creation and use' of rock art (Bradley 1991, 154; Layton 2000). This thesis has demonstrated that often (but not always), engraved art in the Sydney-Hawkesbury region is located in places with high visibility of the landscape. Therefore, visual perception is one of these hidden structures governing the location of engraved art in this region.

The connection traced here between engraved art, visual perception and the landscape meshes with existing research on Australian rock art. Movement emerged as an important theme in relation to visibility. The movement of Aboriginal people throughout the Sydney-Hawkesbury region is known to have occurred based on archaeological and ethnohistorical evidence (e.g. Attenbrow et al. 2017; Collins

1798; Tench 1793). Movement would have been structured by the Dreaming and occurred along Dreaming tracks (Holdaway and Fanning 2014; Witter 2007).

The function of engraved art as a regional social bonding mechanism (as proposed by McDonald (2008, 2000, 1999, 1998) has the movement of people at its core, and current research points to a high degree of mobility in the Aboriginal population of Sydney. The region was home to several broad linguistic groups comprised of smaller clans and bands. Social identity in this context would have been complex and dynamic; Sydney would have been covered by a network of social connections forged by marriage and familial ties linking individuals and groups to multiple places across the region. People would have traversed their territory and others' to hunt, feast, fight, trade, hold ceremonies, arrange marriages and share information. The model proposed by McDonald supposes that the high degree of homogeneity in Sydney-Hawkesbury engraved art is reflective of the art's audience, comprised of a wide range of group affiliations.

As discussed above, the discontinuous Dreaming model argues Dreaming tracks connected people within and between regions across the continent, and motif variation is a reflection of different groups' identities and relationships to the land (Franklin 2004, 2007).

The Track was likely a Dreaming track. Despite more research in this area being required, several facts are in support of this interpretation:

- The Track has been identified as a path travelled by the Wonnarua and Darkinjung peoples for ceremonial purposes (Attenbrow et al. 2017, 182–83; Brayshaw 1986, 41; Moore 1981, 401, 423).

- There is a spatial correlation between rock art and Dreaming tracks (e.g. Gunn 2003; McDonald and Veth 2012).
- Burragurra, a major engraving site containing a high concentration of motifs, as well as particularly good views of Mt Yengo (a place of Aboriginal spiritual importance), is located along this track.

It has already been pointed out that the Dreaming structures geographical space via bodily engagement (David 2002, 25; Tamisari 1998, 250), and that visual perception is part of bodily experience. If The Track was a Dreaming track, then the results of the analysis above indicates places along Dreaming tracks with panoramic views of the landscape were targeted for the production of engraved art.

The results of Analysis B also make sense within this context. Research in several places around Australia has furnished evidence supporting the theory that rock art occurs along Dreaming tracks and was involved in ceremonial activity. This applies to the engraved art in the Sydney-Hawksbury region, with rare culture hero motifs linked to ceremonial activity. Although this association is partly based on ethnographic analogy, the nature of the motifs themselves as well as potential links to tooth-avulsion ceremonies (see Chapter 4) support this relationship. So, assuming sites with culture hero motifs were tied to ceremonial activity, then the high levels of visibility at several of such sites indicate that choices about where to conduct ritual activity were influenced by dramatic or awe-inspiring views. Of course, this was not always the case, with some sites (e.g. Burragurra and Frying Pan Rock) possessing extraordinary views of the landscape yet lacking culture hero motifs. Keeping in mind visibility and behaviour in this context would not have existed in a perfectly linear relationship, the existence of sites with high visibility but without culture hero motifs

does not discount the possibility that visual perception influences behaviour. As is the case for sites along Dreaming tracks, the high levels of visibility at engraving sites with rare motifs indicates these special, restricted, or otherwise different activities are anchored to places with extensive visibility of the landscape.

When interpreted in light of previous research, the results of this thesis suggest rock art correlates with Dreaming tracks and operated to facilitate broad-scale social unity. These findings suggest visual perception was part of the mediation of social identities in prehistoric Sydney. Furthermore, these patterns of visibility are interpreted as evidence that dramatic views are associated with ceremonial activity.

CHAPTER 8. CONCLUSION

This research contributes to a more comprehensive understanding of engraved art in the Sydney-Hawkesbury region. Functional interpretations are useful but overlook other aspects of rock art; while it is impossible to excavate sensory experiences of the past, this thesis demonstrates it is possible to trace attitudes towards visual perception through the archaeological record. By doing so, it is apparent that places with expansive views of the landscape were often (but not always) targeted for the production of engraved art in the region.

It must be noted that the results of this thesis cannot be taken as a clear-cut indication of historical reality. Whether or not a place possesses expansive views in relation to the total landscape was not important in the past; artists chose where to engrave based on the *feeling* that a place had expansive views. Further, visibility was not the only factor influencing the location of engravings. It is almost certain that no single variable can completely account for this. Rather, spatial patterning is likely dependent on a combination of variables. Future studies analysing the locational influence of visual perception in a matrix of other related variables would be of interest. Mobility emerged as an important theme related to visibility, although current understandings of movement through the Sydney-Hawkesbury region are incomplete. Future analyses would benefit from a detailed investigation into this theme in order to create a more nuanced picture of its relationship to visual perception.

At a broader level, this thesis sits alongside other studies pointing to the central role of the senses in human life. It demonstrates that visual perception influenced

behaviour in ancient Sydney, and therefore provides further impetus to archaeologists to consider sensory perception in future analyses.

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Appendix 1. References to the location of engravings in the Sydney-Hawkesbury region

Table 14. Historical and contemporary references to the spatial qualities of engravings in the Sydney-Hawkesbury region			
Author	**Year**	**Quote**	**Place**
HISTORICAL SOURCES			
Governor Phillip	1788	In Botany Bay, Port Jackson, and Broken Bay we frequently saw the figures of men, shields and fish roughly cut on the rocks; and on the top of a mountain I saw the figure of a man in the attitude they put themselves in when they are going to dance, which was much better done than I had seen before, and the figure of a large lizard was sufficiently well executed to satisfy every one what animal was meant.	Sydney-Hawkesbury region
White	1790	We saw, however, some proofs of their ingenuity, in various figures cut on the smooth surface of some large stones. They consisted chiefly of representations of themselves in different attitudes, of their canoes, of several sorts of fish and animals; and, considering the rudeness of the instruments with which the figures must have been executed, the seemed to exhibit tolerably strong likenesses ... The country all around this place was rather high and rocky	Sydney Harbour
Angas	1847	I refer to their carvings in outline, cut into the surface of flat rocks in the neighbourhood, and especially on the summits of various promontories about the harbours of the coast. Although these carvings exist in considerable numbers, covering all the flat rocks upon many of the headlands overlooking the water... After examining the flat rocks in every direction, we found sufficient examples of these singular outlines to confirm at once the opinion that they were executed by the aboriginal inhabitants, but at what period, is quite uncertain.	Sydney Harbour
Mathews	1897	The natives ... would be guided more by the suitability of the rock for their purpose than by its location ... denuded rocks are naturally more general on the tops and sides of hills than elsewhere, we find these carvings are more numerous in such situations than in the valleys, where masses of rock are less plentiful... [although] where circumstances permitted, preference seems to have been given to rocks occupying prominent positions or which were situated in mountain passes along which the natives travelled from one part of their hunting grounds to another.	Sydney-Hawkesbury region
Campbell	1899	The localities selected for these carvings are most varied in character, but they are generally bare of trees. This arises partly on account of the rocky ground where the large smooth surfaces most often occur, and partly perhaps to secure for the more important groups a commanding view of the surrounding country and of sites of other carvings, and the ocean or some sheet of water. The tops of sea cliffs are favourite sites, and also the tablelands which are here about seven hundred feet altitude, and the ridges of the hills along which the natives travelled; sometimes the	Sydney-Hawkesbury region

		bald rocky prominence formed by the crest of a range is selected, at others the smooth rock that frequently forms the floor of a 'saddle', or a ledge towards the heads of a valley, or in the bed of a stream.	
CONTEMPORARY SOURCES			
Stanbury and Clegg	1990	Often, but not always, the engraving sites are prominently situated on outcrops which can be seen from afar. There is invariably a feeling of presence, of atmosphere or tension about the site …	Sydney
Taçon	1999	First of all, rock art sites may be situated near naturally defined "sacred" locations but usually they do not occur right at them. Instead, they more often overlook, indicate the approach to or mark the limits of the more sacred and restricted landscape zones. Secondly, rock art sites are invariably located not far from water...Thirdly, the rock shelters or platforms that were most extensively used for painting and/or engraving are those with prominent, often magnificent, panoramic views...it is almost as if people were situating themselves to take advantage of the visual results of nature's creativity in order to produce or enhance their own.	Australia
Taçon	2006	All five sites are located on particularly high platforms with expansive views in several directions. Their positions in larger landscapes appear to have been purposely selected on the basis of elevation and views to other landmarks	Wollemi National Park
Attenbrow	2010	Most rock engraving sites are on ridgetops and frequently in situations with panoramic views as at West Head and Bondi.	Sydney Harbour

Table 15. Historical and contemporary references to engravings and religious activity.			
Author	**Year**	**Quote**	**Place**
HISTORICAL SOURCES			
Angas	1847	At first the old woman objected, saying that such places were all *koradji* ground, or 'priests' ground', and that she must not visit them; but at length, becoming more communicative, she told us al she knew and all that she had heard her father saying about them … "black fellow made them [engravings] long ago" … they agree in stating that the tribes did not reside upon these spots, assigning as a reason - "too much dibble-dibble walk about"; for they greatly fear meeting the "dibble" or some evil spirit in their rambles, and never leave their camp at night. they state that these places were all sacred to the priest, doctor or conjurer - for the one is the other among these tribes.	Sydney
CONTEMPORARY SOURCES			
Elkin	1949	The Aborigines of the north coast of New South Wales definitely had their most important sanctuaries on high places… and the initiated men of that region whom I know told me of being taken up to such high places on the hills and mountains for the most important revelations and teachings... In other words, it seems reasonable to infer that the location of the petroglyphs in the Hawkesbury-Sydney region is of ritual and mythological significance… we do know that in the course of initiation ceremonies the young men were taken from high place to high place, where they were shown the various sacred symbols and instructed in the mythology and sanctions of the tribe.	Sydney-Hawkesbury region
Kelleher	2002	[Archaeologists] can expect a (highly probable) relationship between emotionally charged geography (e.g. dramatic, unusual, or distinctive features) and the associated material culture.	Blue Mountains National Park

Appendix 2. Visual affordance analysis

2A. Processing and results

Table 16. Visibility inputs and processing times				
Layer	**Surface offset**	**Observer offset**	**Radius**	**Processing time**
Ku-ring-gai Chase visual affordances	OFFSETA	OFFSETB	RADIUS2	20 hours 54 minutes
Yengo visual affordances (NW)	OFFSETA	OFFSETB	RADIUS2	130 hours 46 minutes
Yengo visual affordances (NE)	OFFSETA	OFFSETB	RADIUS2	128 hours 28 minutes
Yengo visual affordances (SE)	OFFSETA	OFFSETB	RADIUS2	132 hours 47 minutes
Yengo visual affordances (SW)	OFFSETA	OFFSETB	RADIUS2	122 hours 27 minutes

Table 17. The visual affordance values of engraving sites analysed in this thesis.	
Site #	Visual affordance value
1	159
2	179
3	216
4	367
5	408
6	498
7	522
8	588
9	592
10	787
11	862
12	1278
13	1336
14	1364
15	1624
16	1731
17	1966
18	2431
19	2927
20	3029
21	3052
22	4224
23	4468
24	5864
25	6687
26	7387
27	8571
28	14252
29	16424
30	11755
31	4932
32	3771
33	311
34	457
35	551
36	917
37	997
38	1260
39	1357
40	1443

41	1582
42	1902
43	1971
44	2020
45	2042
46	2047
47	2124
48	2124
49	2169
50	2344
51	2537
52	2899
53	3074
54	3561
55	3620
56	3887
57	4013
58	5264
59	5968
60	7755
61	9147
62	9466
63	9777
64	10427
65	10534
66	11980
67	13432
68	13726
69	15539
70	16113
71	17095
72	18177
73	19040
74	19040
75	19320
76	19724
78	23156
79	32210
80	32210
81	33282
82	36220
83	39620
84	43009
85	43199

2B. Correlation tests

Ku-ring-gai Chase

Table 18. Correlation between engravings and visual affordance in Ku-ring-gai Chase.

r	0.008
p-value (Two-tailed)	0.050
alpha	0.05

Table 19. Correlation between visibility and motif rarity in Ku-ring-gai Chase.

Variables	Visibility	Motif rarity
Visibility	1	-0.199
Motif frequency	-0.199	1

Table 20. P-value for correlation between visibility and motif rarity in Ku-ring-gai Chase.

Variables	Visibility	Motif rarity
Visibility	0	0.284
Motif frequency	0.284	0

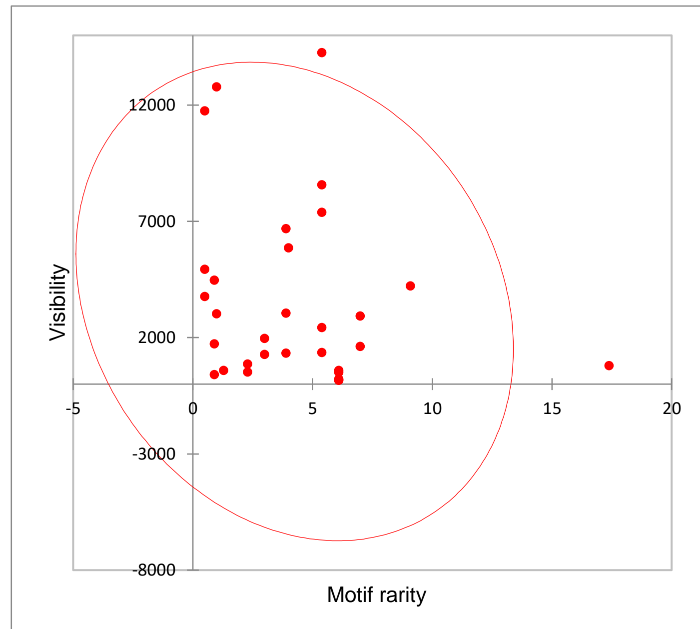

Figure 8. Scatter plot showing correlation between visibility and motif rarity in Ku-ring-gai Chase.

Yengo National Park

Table 21. Correlation between visibility and engraving sites in Yengo.

r	0.006
p-value (Two-tailed)	<0.0001
alpha	0.05

Table 22. Correlations between variables in Yengo.

Variables	Motif rarity	Visibility	Distance
Motif rarity	1	-0.145	-0.084
Visibility	-0.145	1	-0.279
Distance	-0.084	-0.279	1

Table 23. P-values for correlations between variables in Yengo.

Variables	Motif rarity	Visibility	Distance
Motif rarity	0	0.349	0.584
Visibility	0.349	0	0.064
Distance	0.584	0.064	0

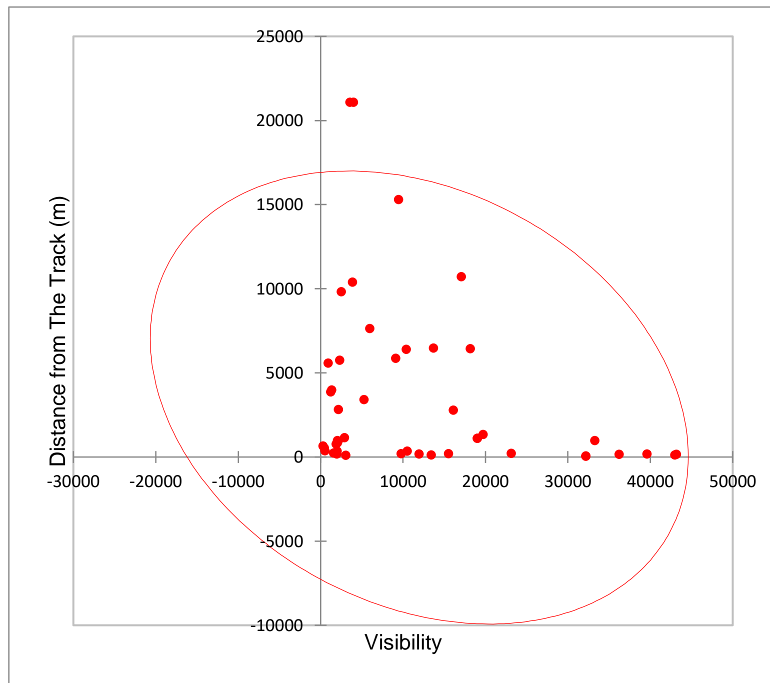

Figure 9. Scatter plot showing correlation between proximity to The Track and visibility in Yengo.

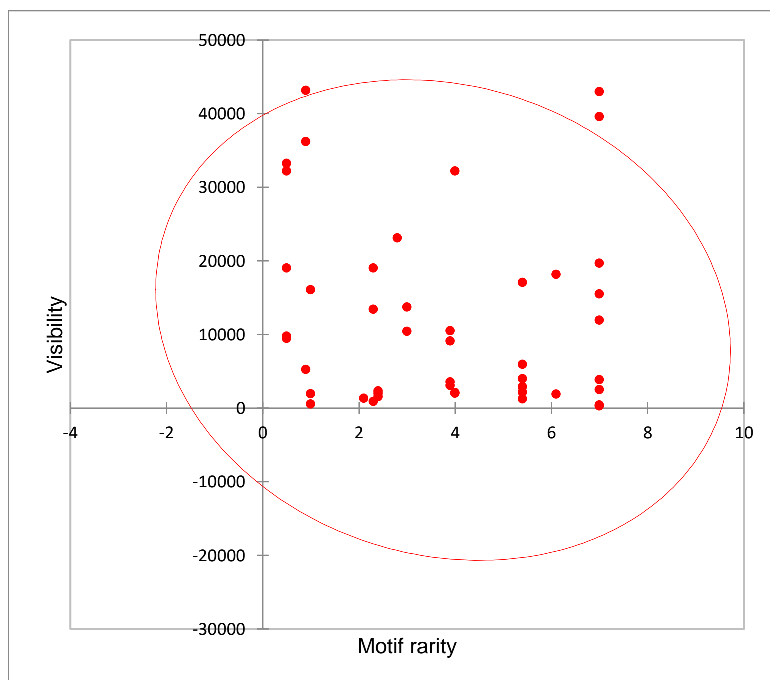

Figure 10. Scatter plot showing correlation between motif rarity and visibility in Yengo.