CHAPTER 1

THE ARCHAEOLOGY OF DESERTS: AUSTRALIA IN CONTEXT

On and on, stepping it out
Across the wide country,
Across the plain.
On and on, stepping it out
Across the wide country
In the heat of the day.

'Travel Song' by Wajurrpirdi, original in *Ngarluma* (von Brandenstein and Thomas 1974: 44)

Of the six inhabited continents, Australia is by far the driest, with large internal areas of desert that make up nearly 70 per cent of the landmass. This immense region of dunefields, ephemeral rivers, saltlakes and desert uplands forms one of the largest desert biomes in the world (United Nations Environment Programme [UNEP] 2006), comparable in size to Arabia or Central Asia; only the Sahara is larger (Figures 1.1 and 1.2). In this book, I have set out to review what we know of the archaeology of Australia's deserts. At one level, this is a record of prehistoric settlement and adaptation in one of the world's major desert regions. On another level, it is also a history of some distinctive Aboriginal societies. Unlike the deserts of Africa, Asia and the Americas, the precontact history of Australia's deserts is exclusively a history of the autonomous development of hunter-gatherer communities descended from the original late Pleistocene settlers of the continent.

POSITIONING THIS RESEARCH

Archaeological research in these drylands has global as well as regional dimensions, and it is worth setting these out at the outset. The first point to make is that the peopling of Australia's deserts represents one end of an arc of dispersal involving the diaspora of early modern humans from Africa (Balme et al. 2009). Exploration and colonisation of deserts and drylands appears to have been part and parcel of this movement. McBrearty and Brooks (2000)

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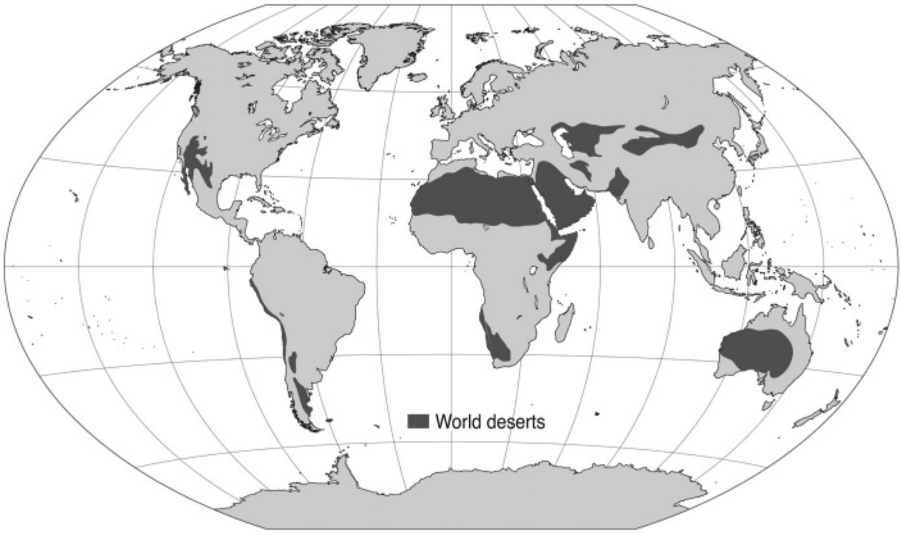

Figure 1.1. The modern distribution of deserts. Based on *Global Deserts Outlook* (UNEP 2006). Australia's deserts form one of the world's major desert regions, as well as the largest desert biome in the Southern Hemisphere.

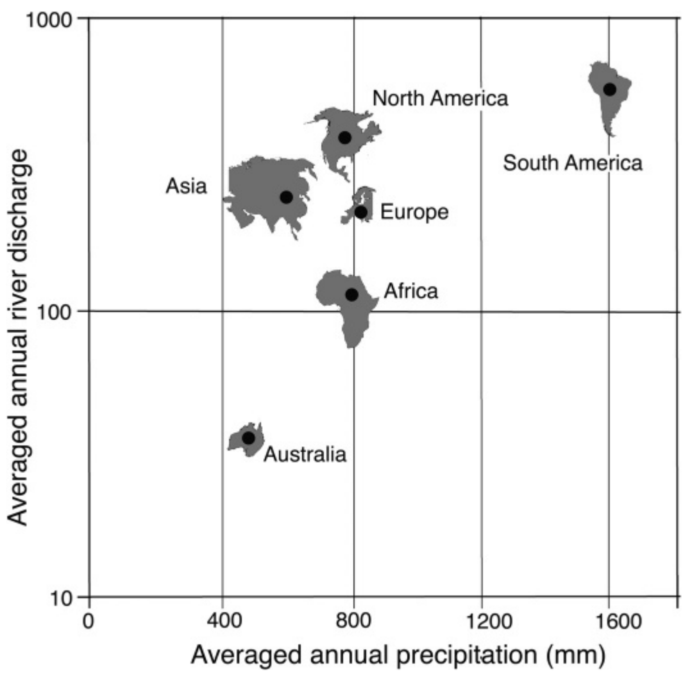

Figure 1.2. Australia is the driest of the six inhabited continents. Just how dry can be seen from the figures for rainfall and river discharge for each continent. Annual precipitation is averaged over the continental area. River discharge is the average annual discharge converted to equivalent rainfall (mm). Australia's deserts represent the extreme end of a largely dry continent but do not include hyper-arid areas comparable to the Sahara, Namib or Atacama deserts. (*Source*: Australian Bureau of Meteorology 2008: 45)

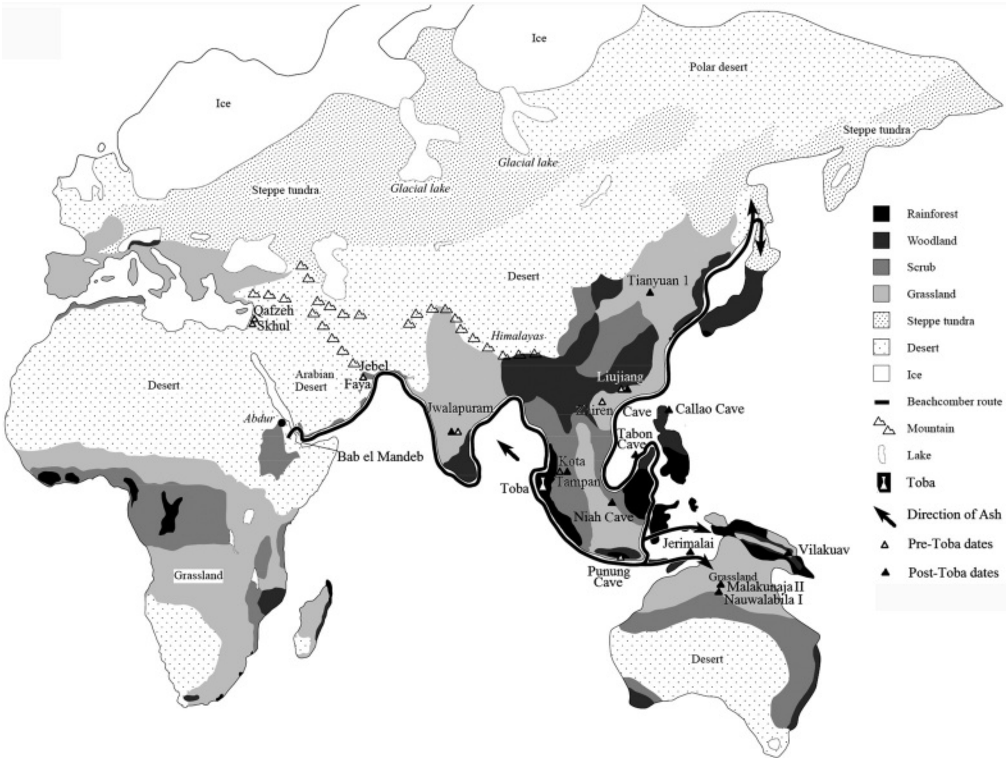

Figure 1.3. The southern route for spread of modern humans out of Africa and into the Australasian region, showing the relationship to world deserts. Map courtesy of S. Oppenheimer (2012: fig. 3).

suggest that Aterian hunter-gatherers settled in the North African deserts from 110 ka down to 60 ka, as one prong of the dispersal of behaviourally and anatomically modern humans (see also Garcea 2004; Barton et al. 2009). The spread of modern humans along the southern margins of Eurasia 80–60 ka brought people to the northern approaches of a prehistoric continent made up of the modern landmasses of Australia, New Guinea and Tasmania (Figure 1.3). The settlement of this continent, around 50 ka, involved two remarkable events: first, the crossings of the Timor Sea and the straits east of the Moluccas to establish separate landfalls on the Australian landmass; and second, the move south from the northern savannas into the deserts and drylands that form the greater part of the continent and represent one of its most distinctive biomes (Byrne et al. 2008). Some 40 years ago, Golson (1971) assembled botanical evidence showing that early colonists from Southeast Asia would have found a range of familiar plant food species in the swamps and woodlands of northern Australia. However, any move inland into the deserts and drylands involved significant adjustments to a new biota. There are questions about how rapidly this move occurred and whether there was a significant time lag between entering the continent and moving into the interior.

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Another theme is the history of the drylands themselves. Australia's deserts have not always taken their modern form: aridity has intensified or relaxed, the deserts have expanded and contracted along their margins and the rivers and lakes of what is now the 'dead heart' have been periodically reactivated. The Quaternary environmental history of these regions is part of a global story of climate change across the last glacial–interglacial cycle. These climatic shifts inevitably affected the ecological baseline for hunter-gatherer groups in the region. One question is whether the interior of Australia was initially settled when the lakes and rivers that ring the heart of the continent were more active than they are today. Another is whether intense aridity during the last glacial maximum led to abandonment of large parts of the continental interior and fragmented the social and economic world of inland groups. The quantum growth in understanding of the Quaternary history of arid Australia – fuelled in part by the availability of new dating techniques such as optically stimulated luminescence (OSL), uranium series (U/Th) and acid–base oxidation radiocarbon dating (ABOX ^{14}C) – now allows a fresh assessment of the environmental basis for prehistoric settlement in this region to be made.

Any archaeology of Australia's deserts is necessarily also a cultural history. Archaeologists working in Central Australia operate in the shadow of the classic ethnographies by Spencer and Gillen. *The Native Tribes of Central Australia* (1899) and *The Northern Tribes of Central Australia* (1904) were founding works of social anthropology and provided prehistorians in Europe with ethnographic analogues for Middle or Upper Palaeolithic societies in Western Europe (Reinach 1903; Sollas 1911; Lubbock 1912). For instance, Sollas famously dubbed the Australians 'the Mousterians of the Antipodes' (1911: 170). Although few social anthropologists after Spencer or Sollas accepted the argument that Aboriginal society preserved elementary or primordial social traits, contemporary foraging groups have often been used as economic analogues for early hunter-gatherer societies on the basis, as Testart puts it, that they preserve 'the most archaic way of life known to humanity' (1988: 1). Archaeological research now complicates this picture by showing that these desert societies have their own histories, and that late Pleistocene societies were not cast in the ethnographic mould. When did life in the desert change to something resembling the ethnographic pattern? One of the concerns of this book is to reconstruct how these societies were assembled over time.

AUSTRALIA'S DESERTS

There are large bands of deserts and drylands along the tropics in both northern and southern hemispheres (Middleton and Thomas 1997). Australia's deserts form the major block of arid lands in the southern hemisphere; taken as a whole, they constitute a classic mid-latitude desert. The region's aridity is a

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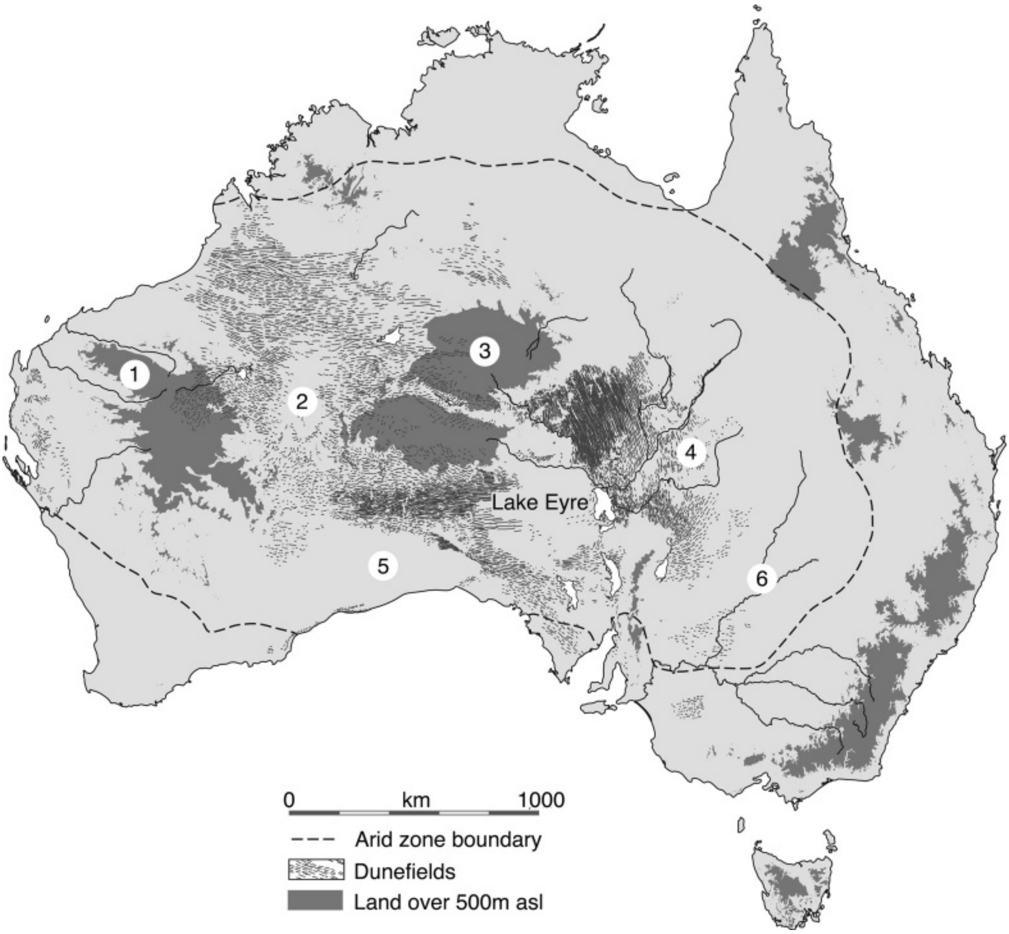

Figure 1.4. The Australian arid zone, showing major geographic features: (1) Pilbara; (2) Western Desert; (3) Central Australia; (4) Arid rivers region; (5) Nullarbor Plain; (6) Darling–Paroo river system. The boundary of the region follows Morton et al. (2011).

product of large-scale subsidence of dry, stable air along the tropics, enhanced by the size of the continent. The geographic boundaries for this block of Australian deserts and drylands are poorly defined – and it is well to remember that modern climate indices are likely to be a poor guide to the extent of these deserts in the past. I use the boundary adopted by Morton et al. (2011). Referring to the standard UNEP aridity index P/PET (a ratio of precipitation to potential evapotranspiration), Morton et al. take a P/PET value of less than 0.4 as the boundary of arid Australia (see also Stafford Smith and Cribb 2009) (Figure 1.4). This includes areas that, on climatic criteria, would be classified as arid and semi-arid (UNEP aridity index: semi-arid P/PET 0.20–<0.50; arid 0.05–<0.20), but aligns better with eco-regions where biota have clear adaptations to arid conditions (see Thackway and Cresswell 1995). The coverage of this book mostly deals with an arid core, that is, the 3 million km^2 area that today would be formally classified as arid on UNEP criteria. However, the wider boundary used by Morton et al. suits my purposes because it also represents the maximum extent of the arid zone during the climatic conditions that prevailed during the late Pleistocene. Throughout this book, I use the terms 'desert' and 'arid zone' interchangeably to refer in general terms to the (shifting) arid core, and 'desert margins' to refer to the semi-arid or dry-subhumid fringes of the desert; and I refer to 'Australia's deserts' whenever I need to remind myself that the 'desert' is not a uniform region.

Diversity is an important theme here. 'Deserts', observed Isaiah Bowman, Director of the American Geographical Society, 'are no more alike than mountains or plains' (1924: 60). This is true in the Australian context, where patterns of rainfall, soil fertility and physical geography vary across the arid zone and frame a range of different opportunities for people. The zone of greatest aridity centres on Lake Eyre – a huge saltlake of 9,690 km^2 – where annual rainfall averages about 100 mm. Out from this, average annual rainfall increases from 250 mm in the south to 500 mm in the north. The greater part of the interior forms an arid core of 3 million km^2, where P/PET is less than 0.20 (meaning that rainfall makes up less than 20 per cent of the potential loss of moisture through evaporation). This is surrounded by a wide belt of semi-arid country, adding another 2–2.5 million km^2.

The named deserts tend to be major dunefields or stony ('gibber') plains, but the arid zone encompasses a wider range of regions. We can list the more important of these, moving from west to east across Figure 1.4:

1. The Pilbara in northwest Australia is a zone of uplands and ranges, between the Fortescue and Ashburton Rivers. Importantly, this region has both an inland and a coastal component and connects the desert interior with an arid west coast that extends from the Dampier region, to Northwest Cape, and on to Shark Bay in the south.
2. In the western half of the arid zone, three sandy deserts (Great Sandy Desert, Little Sandy Desert and Great Victoria Desert) are grouped with the Gibson Desert (an expanse of lateritic gravel plains) and collectively called the 'Western Desert' (Gould 1977: 8). These deserts are part of a continental swirl of dunefields that ring the heart of the continent (Hesse 2010). Most of the dunes here are linear sandridges less than 15 m high and are often stable and vegetated. More than 1.6 million km^2 of the Australian arid zone is covered by aeolian sand, either sandplain or dunefields. All of the sandy deserts also contain small range systems, with rockholes, gorges and run-on areas that provide focal points for human use of the region.
3. The Central Australian ranges form a large block of desert uplands in the heart of the continent – with the MacDonnell Ranges in the north

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and the Mann-Musgrave Ranges south of Lake Amadeus – dubbed 'the Red Centre' by HH Finlayson (1936) for its crimson, deeply oxidised rock faces and red sands. Geographically, this is a plateau 500 m above sea level, broken by the central ranges, which strike east–west across the region in an almost unbroken belt more than 400 km long and up to 160 km wide, separated by narrow sandplains or alluvial valleys. The northern ridges of the MacDonnell Ranges are rugged uplands of crystalline and metamorphic rocks. Local relief commonly exceeds 300 m, and Mt Liebig (1,267 m), Mt Zeil (1,531 m) and Mt Sonder (1,380 m) are the highest points in Central Australia. The major river systems of Central Australia – such as the Finke River – have their headwaters in these ranges, and this is a starkly beautiful landscape with dark red gorges and gum-lined river channels of white sand and gravel. The Central Australian ranges also contain the greatest concentration of rare, relict and endemic plant species in the arid zone, underlining their importance as the major biogeographic refugium in the desert.

4. The eastern desert – the 'arid rivers' region – is a large ephemeral riverine system that includes the catchments of the Mulligan and Georgina Rivers, and the Diamantina–Warburton and Cooper Creek–Barcoo drainages (Robin, Dickman and Martin 2010). These arid rivers intermittently transfer large flows of slow-moving floodwaters from the desert margins towards Lake Eyre, which is the terminus for this vast internal drainage system (Kotwicki 1986). Unlike the sand-bed channels of Central Australia, this is a muddy, in places anastomosing, channel system. During the 2009–10 La Niña, shallow floodwaters reactivated a network of channels, swamps and floodplains, gradually inundating an area larger than Germany. In the lower part of the catchment, these intermittent flows create a sharp contrast between the transient richness of the floodplains and some of the most arid sandridge country in Australia, giving the eastern desert quite a different character to the Western Desert and Central Australia. Towards Lake Eyre, increasing aridity and desolation – as well as the prominence of apparently fossil lakes and palaeochannels – led JW Gregory to label this region 'the dead heart of Australia' (1906).
5. Among this set of deserts, the Nullarbor Plain on the southern margin of the continent has a unique character. This is a vast karst plain, forming a treeless chenopod steppe. Surface water is absent, although solution tubes form natural cisterns in places. From a human perspective, the most habitable part of the region is a narrow strip of arid woodland sandwiched between the open plain and sea cliffs up to 100 m high; it is along this southern margin that massive limestone caves and dolines preserve some of the deepest and best stratified archaeological sites in Australia.

THE ECOLOGICAL BACKGROUND

Plant and animal communities in inland Australia have been 'shuffled and reassembled through filters of increasing aridity' throughout the Quaternary (Morton et al. 2011: 315) and have adapted to a landscape poor in basic nutrients such as nitrogen and phosphorus. However, on shorter ecological timescales, Stafford Smith and Cribb (2009) point out that deserts are characterised not just by scarcity but also by transient richness. Today, Australia's deserts are only moderately arid and mostly well vegetated, with large areas of spinifex (*Triodia*) hummock grassland and arid woodlands. But they experience extreme variation in rainfall and biological production. In some respects, the desert is an unstable extension of the savanna, shrublands and grasslands surrounding the region. Part of the reason for the unexpectedly high perennial biomass is that rain-bearing systems occasionally extend deep into the interior. Rainfall in Australian drylands is influenced by several weather systems, all of which attenuate towards the centre of the continent: the Australian summer monsoon in the north, tropical cyclones in the Pilbara and northwest, and the winter westerlies along the southern margins of the desert (Sturman and Tapper 2006). The monsoon is the most important of these – and the Quaternary record of the desert is largely a history of shifts in the reach of monsoon rainfall into the interior and changes in the strength of this circulation system (Figure 1.5). The net effect of these circulation patterns is infrequent and unpredictable large rainfall events separated by long dry spells that sometimes last for several years. Although variability in rainfall is a generic characteristic of most deserts, Van Etten (2009) showed that the summer rainfall zone of Australia's deserts (north of 27°S) has extreme interannual fluctuations in rainfall, greater than most other desert regions. For instance, Alice Springs, with a median annual rainfall of 259 mm, received only 54 mm of rain in 1985 but a staggering 903 mm in 1974. The region also experiences extremes in temperature: at 69.3°C, an area near Winton was the hottest area on Earth in 2003 (Mildrexler, Zhang and Running 2006).

In the hummock grasslands of Central Australia and the Western Desert, wildfire is an important circuit-breaker in these ecosystems. Fires follow the buildup of fuel loads in good years, recycling scarce nutrients and removing climax vegetation. However, in the arid rivers region east of Lake Eyre, wildfires are less frequent (Morton et al. 2011: fig. 4) and here, episodic flooding is probably at least as important in redistributing nutrients and triggering biological activity. In general terms, the spinifex ecosystems of the western half of the desert are rejuvenated by fire, and those in the eastern part of the desert are rejuvenated by water (in the form of extensive floods).

Despite the influence of erratic and intermittent rainfall on the ecology of these deserts, research has also shown that it is too simplistic to characterise

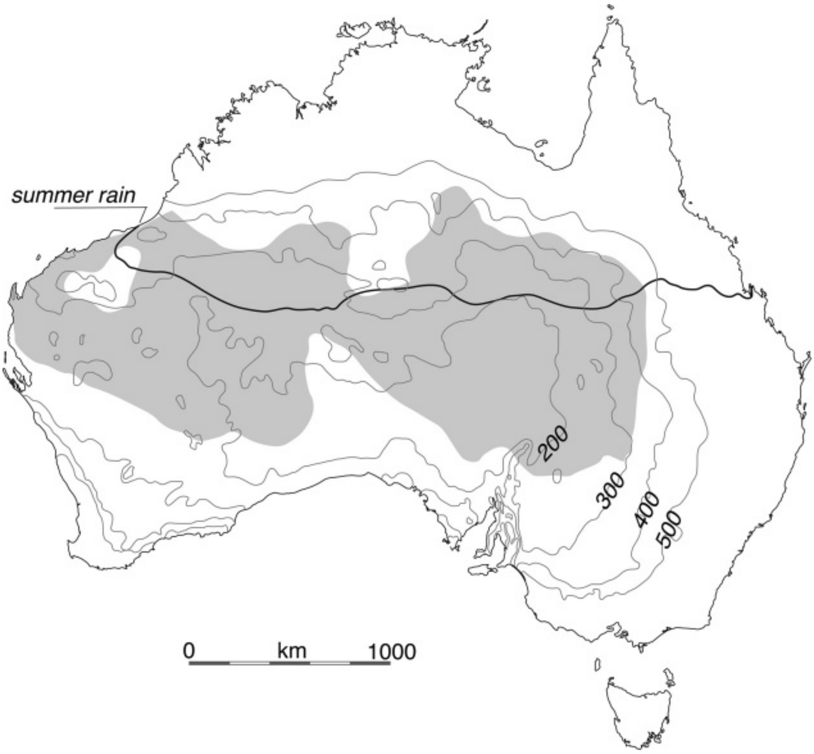

Figure 1.5. Influence of the Australian monsoon on Australia's deserts. Bold line shows the southern limit of the summer rainfall zone (where rainfall in October–March is >3:1 rainfall in April–September). Shaded area shows zone of highest variability in rainfall (1.25–2.0: calculated as 9th decile–1st decile/median). Isohyets show mean annual rainfall. Variability is greatest at the limits of the monsoon. (After Morton et al. 2011: fig. 3)

biotic activity in these deserts as entirely a pulse-and-reserve system, whereby pulses of plant growth are separated by long dormant periods. This is because the high standing biomass and low turnover of plant matter also provide the basis for food webs between booms. Because infertile soils promote longer leaf lifespans and tough unpalatable vegetation, the major herbivores in Australia's deserts are termites and ants consuming plant detritus and exudates. These invertebrate communities are comparatively stable and provide the basis for persistent guilds of consumers: reptiles, birds, insectivorous rodents and marsupials. These in turn provide an array of persistent resources for Aboriginal people, especially in the form of lizards and grubs. In the global context, the density and diversity of reptiles in these environments is unusual: Nosepeg Tjupurrula memorably described the abundance of varanid lizards in *Pintupi* country as making it like a 'poultry run' (Kimber 1988: 48).

THE DESERT'S PEOPLE

Historically, the Australian desert had some of the lowest population densities on record for human populations (as low as one person per 100–200 km^2). At the time of European contact, somewhere between 60,000 and 100,000 people occupied Australia's deserts. Berndt (1959) estimated that the precontact population of the Western Desert was between 10,000 and 18,000 people. For Central Australia, a figure of between 10,000 and 12,000 people seems probable, given population estimates for various areas. The highest population densities were in the ranges and river corridors – ranging from about 1 person per 13 km^2 in the best parts of the Central Australian ranges (Strehlow 1965, 1970), through 1 person per 50 km^2 in other parts of the ranges (Yengoyan 1968; Layton 1986), to 1 person per 90–200 km^2 in the sandy deserts (Meggitt 1962; Long 1971; O'Connell, Latz and Barnett 1983).

Reviewing cultural divisions across the continent, Peterson (1976) found that although arid-zone groups were distinct from those in other areas, the desert was not a single-culture area. The Western Desert groups were the most socially inclusive and fluid societies, including people we know today as the *Martu*, *Ngaatjatjara* and *Pintupi* (Sutton 2003). Some culturally related groups, such as the *Pitjantjatjara* and *Yankunytjatjara*, also occupied range country in the Mann-Musgrave Ranges. There was otherwise a sharp cultural divide, with Arandic-speakers occupying the Central Australian ranges, including the *Arrernte*, *Alyawarr* and *Anmatyerre*. Generally, these societies were marked by richer cultural paraphernalia; denser, more deeply etched mythologies and longer ceremonial song cycles. To the east, groups such as the *Diyari* and *Yandruwantha* along Cooper Creek, and the *Wangkangurru* occupying the Simpson dunefield, were different again. Ranged along a demographic gradient, there were systemic changes in patterns of territoriality and land tenure, with territoriality apparently coupled to population density. Corporate descent groups had primary responsibility for land in Central Australia and probably also in the eastern part of the arid zone (Peterson 1986; Sutton 2003; Keen 2004) but were absent in the Western Desert. In the latter area, 'sociality is stretched to its uttermost and the emphasis is on inclusion': descent is reduced to 'a metaphor manifested in such phrases as, "my father's country" as an explanation or claim' (Peterson 1986: 151–2), although ritual property is still jealously held.

HUMAN ECOLOGY

Deserts are difficult environments for hunter-gatherers, not just because scarcity of water is a limiting factor but also because they are inherently patchy and highly variable on a range of spatial and time scales. Small parts of the landscape – springs, groundwater discharge zones, run-on areas and oases – are often the key to people's use of these zones, especially in Australia's deserts, where plant and animal resources are thinly distributed throughout the region. Here, it is the small surface waters, seepages, wells and springs that provide access to the desert hinterland and a means of stepping through the country. Because the sandy mantle is mostly less than 10 m thick, these deserts have a network of small wells, rockholes and soakages. Although these yield only small amounts of water, it is often enough to provide people with a base for exploiting the resources of the surrounding desert. In the better watered ranges, most people lived in small groups of about twenty people, less than a day's walk from their neighbours and within easy sight of their hunting fires (Peterson 1986: 44–6).

Little theoretical attention has been given to the comparative cultural ecology of desert societies, but sources suggest several potential strategies (Barker and Gilbertson 2000; Veth, Smith and Hiscock 2005):

1. One response is to invest heavily in technology and infrastructure; to harvest or move water through deep wells, qanats or channels; or to store water and food to buffer aridity and scarcity, effectively stabilising returns from the land.
2. Another is ephemeral use of arid regions, exploiting seasonal changes in humidity and pasture to support long-distance transhumance – as some pastoral groups do – effectively evading aridity in time.
3. Some systems focus on major oases, quebrada or wadi systems, or other refuge areas within a desert. This is only viable where these pockets are also zones of very high productivity and where use is coupled with horticulture, as it is in oases in the Atacama Desert of northern Chile and in North Africa. In effect, this means evading aridity in space.
4. Where there are market economies on the desert margins, or demand for exotic or prestige goods, desert groups are sometimes able to exploit their geographic position for raiding or as nodes on important trade routes. Some desert communities, such as San Pedro de Atacama in the Atacama Desert, have grown rich trading with outside groups.
5. For most desert hunter-gatherers, the main strategy was to be highly mobile and opportunistic, as resources ebb and flow over time and space, using pulses of rainfall to disperse across foraging territories and falling back on small wells and waterholes as the country dries out.

The last of these strategies was the one adopted by Aboriginal groups in Australia's deserts. Here, there are few sizable pockets with levels of productivity comparable to the oases in the Atacama in Chile or the deserts of North Africa, and the scale of the Australian arid zone largely rules out transhumance from desert margins.

For hunter-gatherers, mobility is a first-order response to local depletion of bush foods: in desert environments, this is accentuated by low primary productivity, and the spatiotemporal distribution of water determines how you step through the country. Ethnographically, the general pattern for these Aboriginal groups was to take advantage of rain to visit outlying parts of a foraging territory and to exploit the bush foods in these areas while they were accessible (Thomson 1964; Gould 1969a; Allen 1972; Tindale 1972; O'Connell 1977; Tonkinson 1978; W Jones 1979; Cane 1984; Kimber 1984). The temporary waters that supported these visits included claypans, soakages, rockholes and shallow wells. These were short-lived and often unpredictable. As they dried up, people fell back to camps near the main waters. The bush foods around these camps were left in reserve until foraging was restricted during the dry season to areas around the main waters: 'the Aborigines,' as Gould put it, 'eat their way into a camp by first exploiting all the food resources whenever possible before settling at the main waterhole' (1969a: 267).

The lives of these desert people were deeply affected by uncertain rainfall and irregular production. People tailored their land use to take advantage of rain to access fresh foraging patches; they co-opted large pulses of biological production as opportunities for larger gatherings and ceremonies; and, during protracted droughts, the population would fission into small groups, dissolving as individuals activated their social networks to take up residence in neighbouring territory. People attempted to stabilise returns by stockpiling some foods to meet seasonal shortfalls and to stabilise access to country by maintaining wells and capping rockholes.

Tonkinson commented on the 'continuing dialectic between the ecological constraints that push people apart and the cultural pressures that draw them together' (1978: 30). One of the challenges was to maintain a territorial and land tenure system that could operate in the face of a high degree of fluidity in residence patterns, group composition and the distribution of people on the land. Stanner (1965) draws a key distinction between an 'estate' (the religious core owned by a descent group) and the 'range' (the wider foraging territory). Aboriginal people attached themselves to foraging groups wherever they could establish some links and rights of access. This created residential groups loosely made up of people related through marriage, direct kin relations, place of conception or birth, ritual knowledge or perhaps the death of a parent or grandparent in the area. Underlying this, however, was a formal landscape of clan estates – usually an area of 900–1,500 km^2 containing at least one reliable water source – in which a group of kin claimed primary tenure.

THE ARCHAEOLOGY OF DESERTS

The archaeology of deserts is rarely treated as a discrete field of inquiry, but a stronger comparative framework would clearly benefit archaeological research across the world's arid regions (Barker and Gilbertson 2000; Smith and Hesse 2005; Veth et al. 2005). Arid landscapes often bear the imprint of past climates in dry lakes, abandoned river channels or fossil dune systems. Climate change can reactivate a desert landscape or leave it stranded and lifeless. Small shifts in rainfall or groundwater can have dramatic consequences for desert communities. 'Places die, just as men do,' says Joseph Joubert (in Depardon et al. 2000: 102). It is not surprising, therefore, to find that desert research hinges on similar questions: whether prehistoric settlement in areas now deserts was restricted to humid episodes, or whether increasing aridity led to the abandonment of entire regions or fragmented existing patterns of settlement, creating significant gaps in occupation sequences.

In practical terms, the sparse ground cover in deserts means that archaeological sites, rock art and stone arrangements are highly visible. For this reason, work on open sites is a feature of research in these areas. Although this is true in Australia's deserts (e.g., Smith 1988; McConnochie 1996; Holdaway, Fanning and Shiner 2005; Hughes et al. 2001), the poor stone tool systematics means that, here, phasing of sites relies on direct dating of stratified deposits or remnant hearths to a greater extent than in other desert regions. Taphonomic problems are common to many regions and include the cycling of lags of artefacts in mobile dunes with repeated episodes of deflation and reburial (Hughes et al. 2011), and reworking of stone tool scatters on spatially extensive deflation surfaces (Fanning et al. 2009). Archaeological remains in stratified deposits are generally well preserved, but Australia's deserts lack the preservation of wood, bone, fibre or plant material commonly found in archaeological sites in hyper-arid regions.

The archaeological record for arid Australia is striking for its austerity: the archaeology of these hunter-gatherer systems relies as much on context as on material remains. Most sites have few artefacts and few categories of remains (usually only chipped stone artefacts, grindstone fragments, red ochre and charcoal). Many archaeological deposits are shallow, often no more than a metre deep, and poorly (or cryptically) stratified. Yet the history of research over the last 30 years suggests the regional records are remarkably robust. Most areas show a repeated pattern of discovery of sites with broadly similar age ranges, sequences and site assemblages.

Australian research widely employs an approach that focuses on strategic points in the desert landscape – usually near critical waters, often in small gorge or range systems – and on reconstructing site histories. This is basically an 'archaeology of place' in the sense Binford (1982) describes. Characteristically, fieldwork has involved small rockshelter or open-site excavations, in locations where the excavated sites are part of complexes that include clusters of occupied rockshelters, open sites, stone arrangements, engravings and rock paintings (e.g., Thorley 1998b; Smith and Ross 2008; Veth, McDonald and White 2008). Many rockshelter deposits are extensions of occupation on adjacent sand mantles, blurring any straightforward dichotomy between open and rockshelter sites. In the depositional landscapes of Central Australia, stratified open sites are common (Smith 1988). However, in the southeastern part of the arid zone, extensive scatters of stone artefacts on deflation surfaces are more common – and these represent major geomorphic challenges to unpack (Holdaway et al. 2005). Most burials and skeletal material have also come from the southeastern margins of the arid zone, where calcareous soils preserve bone – in contrast to the rest of the arid zone, where bone is rarely preserved beyond a few hundred years.

There are some obvious caveats in interpreting site data. Excavations are often limited to small exploratory trenches, not all of which are reported in detail, and few sites have been subject to reinvestigation. Few sites have seen detailed analysis of their sedimentary or geomorphic history. Samples of stone tool assemblages are invariably small and, for larger sites, usually represent only one of the potential discard zones within a rockshelter – with consequences for the type of assemblage recovered. Few excavators explicitly attempt to isolate and characterise separate phases of occupation in any detail. For some late Pleistocene sites, it is not clear whether the archaeological remains represent discrete, widely spaced pulses of occupation within a slowly accumulating sediment matrix, or whether they reflect the slow, continuous accumulation of a few artefacts per century. There are also some cautions in how we interpret site records in behavioural terms. Most excavation units probably represent palimpsests of different sorts of occupation, with a mix of short-term and extended-stay visits.

These problems are accentuated by the coarse resolution of chronologies for late Pleistocene sites (where luminescence and ^{14}C dates often have uncertainties of several thousand and several hundred years, respectively) and the lack of fine-grained sampling for radiocarbon chronologies for Holocene sites. Larger excavations and detailed analyses of individual site records potentially offer both greater precision and a richer picture of late Pleistocene and mid-Holocene societies – as work at Puritjarra, Lake Tandou TN36, Puntutjarpa and Skew Valley shows (see Chapters 4–6). The most important challenge for archaeologists in the Australian arid zone is to more fully exploit the intrinsic potential of late Pleistocene sites as archives of the cultural and economic landscapes in which they are embedded.

THE POLITICS OF PRACTICE

Other issues concern the contemporary political and economic situation in Australia's deserts. Biologists, ecologists, archaeologists and anthropologists all benefitted from the four-wheel drive (4WD) vehicle revolution that swept remote Australia from the 1960s onwards. But the same forces that opened up

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the desert for archaeological research also placed more constraints on where, when and how this research could be done. Since the passage of the *Aboriginal Land Rights (Northern Territory) Act* in 1976, the *Anangu Pitjantjatjara Yankunytjatjara Land Rights Act* in 1981, and the *Native Title Act* in 1993, archaeologists have required community approval to work on most lands in the region. Most state and federal jurisdictions manage archaeological sites as a form of cultural property and require appropriate consultation at the community level before issuing permits for field research. This is no bad thing in itself but imposes long lead times for field projects, mostly beyond the term of a PhD project or a 3- to 5-year research grant. Although many veteran archaeologists have long-standing working relationships with particular communities – often extending over several generations – it has become much more difficult for students or new researchers to enter the field. The current cohort of senior researchers represents the last to have been involved in primary archaeological exploration of the continent and the last generation to have the opportunity to travel and work with desert people who have spent part of their lives in the bush without significant European contact.

There has been little direct impact on research agendas or the types of research questions posed by archaeological projects. The main effect has been a shift away from regional surveys by solo researchers towards larger ramified multidisciplinary projects, often with bush communities as formal partners. These sometimes embed archaeological research within a wider project of cultural mapping, heritage management or community art. Archaeologists also find themselves working for land councils as part of native title claims, although my own experience is that bush people sometimes see the task of archaeology as providing tangible evidence of the 'dreaming' rather than as a dispassionate examination of evidence for precontact occupation of an area. Over the last 30 years, archaeology has become increasingly part of the fabric of contemporary life in the desert and a point of articulation among bush communities, government agencies, industry and wider Australian society. For instance, in support of the successful *Spinifex (Pila Nguru) Native Title Claim* in 2000, Chief Justice Michael Black noted that 'the archaeological evidence suggests the emergence of a rudimentary nomadic society in the Western Desert at least 20,000 years ago' (Hickman 2000: 7).

Another factor shaping archaeological research in Australia's deserts has been the boom in iron ore and coal mining and in oil and gas exploration, especially in northwestern Australia. Since the 1980s, this has generated archaeological survey and salvage projects in the Pilbara, but the last decade, in particular, has seen an explosive growth in this type of work, to the extent that salvage and survey contracts now employ the majority of archaeological graduates. Much of this fieldwork is of very uneven quality, aimed at compliance with legislation rather than at answering research questions. Few sites are reported in detail, fewer are published, and it is rare to find that sufficient work has been done to characterise the nature of occupation at sites or provide a detailed site chronology. Nonetheless, this large grey literature is a boon for researchers, and there have been attempts to put work in the Pilbara on a firmer research footing (Morse 2009). This Pilbara research has also produced a large excavated dataset and a remarkable suite of late Pleistocene sites.