Committee), special fields of expertise, specialist studies, and consulting experience. The Register provides summary contact details, expertise, and availability of Associate Members and lists all Affiliate Members. The AACAI website lists all financial Full Members' details as well as all policy documents. AACAI can serve to lobby collectively on issues deemed to be of interest to its professional membership, such as amendments to heritage legislation. It has formal ties with other archaeological organizations, including the Australian Archaeological Association.

Cross-References

- Australian Archaeological Association Inc. (AAA)
- Ethics in Archaeology
- Heritage and Archaeology

Further Reading

AUSTRALIAN ASSOCIATION OF CONSULTING ARCHAEOLOGISTS INC. (AACAI). n.d. Available at: www.aacai.com.au.

Australian Deserts: Extreme Environments in Archaeology

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State of Knowledge and Current Debates

Introduction

The first Australians passed through biogeographic filters of the increasingly depauperate

islands of Wallacea to enter the most arid continent ever occupied by preindustrial era humans. But were Australia's deserts marginal, extreme, and risky environments for these hyper-adaptive modern humans? We must recall that they were part of a "fast track" southern diaspora of modern humans from Africa to Australia who had already shown extraordinarily adaptive abilities. Given that the Last Glacial Maximum expanded Australia's deserts even further and made for some truly extreme environments, what does archaeology tell us of how Ice Age Australians dealt with the most common environments in Sahul? By the time Europeans arrived in Australia, the deserts were more densely packed with people than ever before, a process that had escalated in the late Holocene to create the renowned desert societies known to ethnographers. Even then, these were some of the lowest density populations ever observed (in some instances one person per 100–200 km²) (Hiscock 2008). Australian deserts, and desert peoples, have now moved close to the center of Australian society for the first time, providing a vital pump for art and ideas from the desert outward. Here we review Australia's deserts from an archaeological perspective.

Modern humans left Africa between approximately 70,000 years ago (cal BP (years before 1950) is used here to denote calendar years; years BP and BP are used to denote radiocarbon years; ka is used to denote thousands of years ago and generally relates to OSL ages. The Pleistocene period extends from 2 million to c. 10,000 years ago, and then the Holocene epoch begins) and reached Sahul at the eastern end of this diaspora before 50,000 years ago (Smith 2013). This was an impressive accomplishment, since it entailed crossing through Wallacea, which encompasses the islands of the Lesser Sundas including Flores and Timor, and would have required a series of substantial water crossings out of sight of land (Fig. 1). With the exception of Flores, the archaeological evidence left by the early colonists is indisputably the product of modern human behavior (Balme et al. 2009).

Currently the oldest sites are found in Arnhem Land in the north of the continent. These sites are

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Fig. 1 Map of
archaeological sites
discussed in text:

(1) Malakunanja
rockshelter, (2) Nauwalabila
rockshelter, (3) Parnkupirti,
(4) Devil's Lair rockshelter,
(5) Allen's Cave,
(6) Cuddie Springs,
(7) GRE 8 rockshelter,
(8) Madura Cave,
(9) Mandu Mandu
rockshelter, (10) Riwi
rockshelter, (11) Puritjarra
rockshelter, (12) Arltunga,
and (13) Killalpaninna
mission

not far from the coast today but would have been a significant distance inland at the time of first occupation. Dates of between 65,000 and 50,000 BP have been obtained for sediments in association with the lowest stone artifacts recovered at rockshelter sites Malakunanja and Nauwalabila 1 based on the optically stimulated luminescence (OSL) method (Fig. 1). Sites in the inland arid zone such as at Lake Gregory (*Parnkupirti*) have been dated to between 50,000 and 45,000 (Veth et al. 2009). Using the radiocarbon technique that dates charcoal and other organic remains, dates in the order of 50,000–45,000 cal BP have been obtained for sites in both northern and southern Australia (Balme et al. 2009). A spectacular limestone cave in the extreme southwest of Western Australia, Devil's Lair, currently has the oldest radiocarbon date for occupation approximately 48,000 BP (Turney et al. 2001) – to get here would have required passing by, or through, the arid regions of the northwestern reaches of the continent. Thus, while once thought to have been barriers

to human occupation until the Holocene, with many analogues to the Great Basin of the USA, desert sites from Australia in the order of 40,000 BP predating glacial aridity are now well established (Hiscock & Wallis 2005; Smith 2013).

Australian deserts are not uniform, and the impact of environmental transformations over time was variable. The deserts exist across a massive belt of semiarid and arid Australia. In the east arid, regions around Lake Eyre contrasted with the large occasionally active river systems such as Cooper Creek. While people such as *Diyari* benefited from rivers, others were suited to more extreme deserts, such as Wangkangurru dwelling in the dune fields of the Simpson Desert. Moving westward, Central Australia is broken by sets of ranges occupied by *Arrandic* speakers, which had long provided a highly elevated refuge at the continent's heart. Further west, the massive Western Desert combines several separate deserts, both sandy and gravel in form. For humans in these

environments, such as *Martu* and *Pintupi* peoples, life in the sand-dune country required the use of ephemeral waters and more reliable water in rock holes found in small ranges like the Cleland Hills. Reaching the Western Australian coast, the Pilbara is a vast set of ranges extending from the Western Desert to the arid Indian Ocean coast, now clearly never abandoned at any stage in Australia's past. In the south, the Nullarbor Plain also borders an ocean, the Southern Ocean, abutted by a vast flat, often un-vegetated plain, with little surface water.

The Climate of the Arid Zone

The climatic history of Australia's desert provides a critical frame through which to understand human uses of the arid regions which have witnessed some of the most dynamic human-landscape transformations anywhere (Veth 2005).

The climate of arid Australia is characterized by several drivers, notably the northern summer monsoons, cyclones, and pseudo-monsoons in the north and winter westerlies and frontal systems in the south (Sturman & Tapper 1996). The major river systems that bring rain from the monsoon belt into the arid interior and fill water bodies such as Lake Gregory, Lake Woods, Lake Eyre, and Lake Frome also play a significant role in the availability of water and thereby accessibility of the desert (Williams et al. 2010). Changes in the strength and location of these systems, therefore, have large influence over the effective precipitation in the arid interior and indirectly affect other hunter-gatherer requirements, including food resources, vegetation, fire regimes, and water availability.

At the time of human arrival, the arid zone was cool but humid, with several of the large lakes (including Lake Frome, Lake Gregory, and Lake Eyre) containing water from intensified summer monsoons and/or an equatorward displacement of the winter westerlies (Fitzsimmons et al. 2012). These conditions, which would have allowed the exploration of much of the arid interior, persisted until the onset of the Last Glacial Maximum (LGM) beginning at ~30,000 years BP and peaking at ~23,000–18,000 years BP.

The LGM in Australia was a period of significant cooling and increased aridity (Fig. 2) and saw a decline in annual temperatures by as much as 10 °C compared with present day; glaciation of uplands in the Snowy Mountains and Tasmania; reduction in rainfall by 60 % or more, especially in the interior through the weakening of the summer monsoons and poleward displacement of winter westerlies; changes in vegetation structure to generally more steppe-like and grassland-dominated environments; lower lake levels; increasing dune activity and dust transport; and an expansion of the arid zone into semiarid and mesic environments (Williams et al. 2009; Petherick et al. 2011; Fitzsimmons et al. 2012). Sea levels were also at their lowest through this period, at ~120 m below modern day levels, and led to increased continentality across the interior. In the arid zone, only the Murray-Darling Basin system showed evidence of continuing resources, being fed by water from the ice fields covering the Snowy Mountains during this period. Fluvial activity at the headwaters of the Cooper River and high lake levels at Lake Lewis, however, suggest episodic wet events occurred within, or on the margins of, the arid zone throughout the LGM.

Following the LGM, the Terminal Pleistocene/Holocene transition saw rapid environmental change. Increasing temperatures initially outpaced precipitation and, at least for prehistoric people, probably led to some of the driest conditions in the last 50,000 years (Markgraf et al. 1992). Sea levels rose rapidly and by 12,000 years BP had reached present-day levels, inundating the continental shelf and likely displacing significant populations in the (now) Timor and Arafura Seas. Lake Carpentaria would similarly be inundated by ~8,000 years BP. Recent studies show this period to be one of increasing complexity, with the southern parts of the continent having a brief humid phase between ~17,000–15,000 years BP before increasing aridity at ~14,000–10,000 years BP, while in the north the lapsed monsoon saw dry conditions until after 14,000 years BP after which it got progressively wetter (Fitzsimmons et al. 2012). In the center of Australia, the Todd River reveals

Australian Deserts: Extreme Environments in Archaeology, Fig. 2 A summary of paleoclimatic proxies from northern and southern Australia (Fitzsimmons et al. 2012)

evidence of paleo-floods initiating from 14,000 years BP and continuing into the early Holocene (Smith & Ross 2008).

In the early Holocene, ameliorating climate would have allowed far greater access into the arid interior. An area that had generally been fairly inhospitable to long-term occupation now had increasing resources due to an intensification of the monsoon system brought about by the inundation of the Sahul Shelf (Smith 2013). Rainfall from the increased monsoons fed the major rivers systems running into the center of the continent, and Lake Eyre, Lake Frome, and Lake Gregory were, again, all full (Smith et al. 2008).

From approximately 5,000 years BP, the current El Niño-Southern Oscillation (ENSO) cycle was initiated (Shulmeister 1999). Beginning as a period of increased effective precipitation and enhancement of the monsoons across Australia,

the climate quickly turned to prolonged drying and increased variability. Intensification of ENSO would have caused the movement of the Intertropical Convergence Zone northward, increased the anticyclonic conditions overlying the region, and thereby reduced the likelihood of monsoon or rain-laden low-pressure systems into the Australian interior. Between ~3,700 and 2,000 BP, this intensification of ENSO caused significantly drier conditions in Australia and increasing climatic variability in the arid interior. A number of different datasets all demonstrate that ENSO, and specifically El Niño events, was consistently stronger and more frequent during this period. However, while the overall effect of ENSO was to reduce rainfall in this period, increasing variability would have seen significant rainfall in the interior occasionally.

The intensification of El Niño events continued and may have increased until approximately

Australian Deserts: Extreme Environments in Archaeology, Fig. 3 A graph showing proxies for population and/or human activity compared with paleoclimatic records. (a) Summed probability distribution

(dashed) of radiocarbon dates from archaeological sites in the arid zone. Taphonomic correction of the radiocarbon data is also presented (dark gray line provides the corrected values with associated 95 % confidence

1,500 years BP. Several Australian paleoclimatic datasets suggest amelioration from 2,000 to 1,700 years BP or later. Consequently, the climate of the last 2,000 years was considerably more stable than the mid-Holocene, although there were the well-known climate shifts of the wetter Medieval Climatic Anomaly at 1,200–800 years BP and the cooler Little Ice Age at 600–200 years BP (Williams et al. 2010).

Regional Trends: Time-Series Analysis

Recent approaches in the use of time-series analysis provide a good opportunity to explore the first-order response of prehistoric people to the climatic changes outlined above. Techniques to explore regional response fall into three main categories: (1) the use of summed probability approaches – involving the compilation of radiocarbon data from archaeological sites as an indicator for population size and/or mobility (Fig. 3a); (2) the interpretation and compilation of individual site records to give an inference of peak occupation periods (Fig. 3b); and (3) artifact z-scores, a standardization approach taken from recent paleo-fire studies that allows integration of a wide range of spatial and temporal records into one regional curve (Fig. 3c) (Williams 2012).

As Fig. 3 demonstrates, occupation of the arid zone began soon after colonization. There are now eight sites that would have been located within the expanded arid core of Australia before and during the Last Glacial Maximum. The oldest is *Parnkupirti*, located on a tributary of the once mega-lake of Lake Gregory in the southeastern Kimberley dated from 50 to 45 ka. Lake Gregory

itself would have once been a very large freshwater lake fed by the Kimberley ranges to the north and containing shellfish, fish, water fowl, and myriad of fauna such as emu and macropods. Other sites in the Kimberly are dated to 45 ka, while at the western edge of the Central Australian ranges, Puritjarra rockshelter shows evidence for occupation between 40 and 35 ka BP. On the Nullarbor Plain to the south, Allen's Cave has an OSL date of 40 ka, while the earliest occupations at Lake Mungo to the east are estimated by OSL to lie in the range of 50–46 ka. To the northeast, Cuddie Springs dates to 38,500 years ago, while a shelter near Lawn Hill in Queensland (GRE 8) has a radiocarbon determination of 41,500 cal BP (Hiscock 2008; Smith 2013).

Following colonization, human activity and/or prehistoric populations grew slowly until the LGM, when several of the indices show a decline in data. This corresponds with well-documented abandonment of large tracts of the arid interior, population decline, and the falling back of surviving populations into refugia, including the Pilbara, Central Australian ranges, and Murray-Darling Basin (Veth 1989, 2005) (Fig. 4). (It should be noted that the z-score results here are heavily influenced by the Puritjarra rockshelter record, which formed a refugia during this event, and explain the increase in artifact discard during this time.) After a brief recovery, a similar decline in activity is evident during the ACR. Not previously considered in archaeological literature, the ACR probably saw a similar human response as the LGM. With the exception of the LGM

Australian Deserts: Extreme Environments in Archaeology, Fig. 3 (continued) intervals (*pale gray shading*); *black line* presents a 3-point (equivalent to 750-year) moving average. No smoothing or zero trimming was attempted); (b) using data from 58 archaeological sites in the arid zone, a graph showing number of occupied archaeological sites by 500-year time intervals (*dashed lined* shows number of sites; *solid line* shows periods of increased artifact discard or other archaeological indices), (c) mean z-scores of artifact discard rates (effectively a regional signal) of nine Central Australian rockshelters: Wanmarra, Wanga East (WO4), Ilarari 17,

Rrewurpmlpme Kweke, Intirekwerle, Urre, Kweyunpe 6, Therreyererte, and Puritjarra. (d) EPICA Dome C ice core deuterium/hydrogen ratios – a proxy for temperature, (e) sea-level change from sediments in the Red Sea, (f) a record of El Niño-Southern Oscillation from an ocean core, SO147-106KL, off the coast of Peru – a proxy for rainfall. Climatic periods are shown, including the Last Glacial Maximum (LGM), Antarctic Cold Reversal (ACR), mid-Holocene climatic optimum (MHC), and intensification of El Niño-Southern Oscillation (ENSO). See Williams (2012) for further information and methods presented in this figure

Australian Deserts: Extreme Environments in Archaeology, Fig. 4 Conceptual map of barriers (sand sheets), refuges (uplands), and corridors (interstitial lowlands) used by Aboriginal people during climate perturbations from earliest pluvial phase, expansion of the arid interior during the Last Glacial Maximum, and then subsequent amelioration and climatic fluctuations of the Holocene. Developed by Veth (1989) as a heuristic model

to provide a framework for understanding some of the dynamism in the timing, settlement, and mobility of desert societies, this has been supported in large by 25 years of desert studies (cf. Hiscock 2008). The new cryptic refuge model of Smith (2013) sees smaller satellite refugia outside of the major uplands – as deduced from studies of faunal biogeography – especially for persistence of populations during the LGM

and ACR, the data suggests that the Terminal Pleistocene was generally a period of decline or period abandonment in the arid interior.

After the ACR and in tandem with ameliorating climate, significant increases in populations/human activity can be observed in the Terminal Pleistocene/early Holocene between ~12,000 and 8,000 years BP (Smith 2013). A significant increase in both radiocarbon data and artifact rates can be observed during this period, and several sites were occupied for the first time (e.g., Puntutjarpa rockshelter in the Musgrave Ranges, Norina Cave and Madura Cave on the Nullarbor Plain, and Marillana A rockshelter in the Pilbara uplands) or contain evidence of intensified occupation (e.g. Allen's Cave on the Nullarbor Plain and Puritjarra rockshelter in the Cleland Hills).

The initiation of ENSO during the late Holocene led to a series of changes in the

configuration of Aboriginal populations, between ~4,000 and 2,000 years BP, including responses inferred as regional abandonment and population decline. During this period, the use of hafting technology, the appearance/proliferation of microlithic tools (e.g., tula adzes and backed blades), and the standardization of stone tools, intensifying long-distance trade and ritual networks, all occur for the first time (Smith 2013).

After 2,000 years BP, hunter-gatherer populations may have increased exponentially, a fact identified by several authors but yet to be adequately explained (Smith & Ross 2008). Importantly, this increase is still prominent in the taphonomically corrected data, indicating it is not an artifact of site loss through time (Williams 2012). This period also saw a series of new adaptive responses to climatic variability, including

marked increase in use of marginal and outlying sites, the extended use of existing sites, increased territoriality expressed through greater differentiation of rock art, and more intensive use of lower calorific food resources, such as *Acacia* and grass seed processing. Recent work has shown this period to be increasing complex with human responses to events such as the Medieval Climatic Anomaly (Williams et al. 2010).

Human Response to Extreme Environments

Conditions were generally more favorable when groups entered Sahul c. 50,000 years ago, meaning that people were not entering the daunting and ostensibly “dangerous” landscapes lamented by early European explorers – although this can be in part explained by European lack of familiarity with these environments. These favorable conditions then became more diverse and in many cases challenging by 30,000 BP. This has been labeled the “desert transformation model.” In this scenario, groups first adapted to more benign climates and then made changes in their settlement behavior, technology, economy, dietary suites, and material culture to accommodate significant changes in the landscape.

Environmental reconstructions suggest that while conditions would have been colder than today, other factors may have promoted early movement inland. Hiscock and Wallis (2005) make the case that:

In many regions it is likely that up until 45,000 years ago – and perhaps to 30,000 years ago in some locations – the availability of fresh surface water would have been at least as good, if not better, than during the Holocene...The greater relative availability and predictability of resources...would have facilitated exploration and exploitation of these unique interior landscapes.

These recent environmental reconstructions, coupled with the patterning of radiocarbon dates and economic evidence from numerous archaeological sites, support a very early movement of people into well-watered inland regions, and here we would argue the “extreme” deserts of Australia.

Groups not only occupied radically different environments in a relatively short period of time; they also began to develop signature regional

traits. Interestingly many of these are sources from the then expanded arid zone of Australia. These are inferred from differences in tool production, long-distance exchange networks (witnessed in movement of ochre specimens), complex funerary practices (such as at Lake Mungo at the Willandra Lakes), and very different group-identifying behaviors that have been interpreted from different art styles thought to date to the Pleistocene period (such as the engraved Archaic Faces found from the Pilbara and then in a vast swathe across the western, central, and arid lands on the eastern border).

Lumps of faceted ochre, grindstones on which ochre has been ground, and slabs smeared with ochrous pigment date back to c. 42,000 years ago, from sites in the southwest Kimberley and from a burial site in Lake Mungo, from excavations in Arnhem Land, and from excavations dated to >32,000 BP from Central Australia (Hiscock 2008). It is assumed that ochres were used in the earliest pigment art and that it was likely part of the repertoire of Indigenous Australians (Veth et al. 2011).

Shell beads were important signals of modern behavior in Africa and the Levantine. Representing items of personal adornment and identity, they have now been recovered from Australasia as well. The two key sites of Mandu Mandu Creek rockshelter and Riwi lie on the edge of the deserts of northwest Australia and have yielded “strands” of 22 cone shells older than 32,000 BP and 10 tusk shells dated to approximately 30,000 BP, respectively (Balme & Morse 2006). Such regionally distinct personal wear is seen to have helped in mediating interactions within and between groups.

Long-distance exchange can be inferred from artifacts that lie well outside their supply zone and can be sourced accurately. The oldest comes from a burial site in the Willandra Lakes, more than 40,000 years old, where the closest source for ochre is the Barrier Range some 250 km distant. Ochre as old as 32,000 BP was transported 125 km to the Central Australian site of Puritjarra, while ochres from Mandu Mandu Creek rockshelter in northwestern Australia were transported over 300 km as early as 25,000 BP. Pearl, baler, and tusk shell were moved up to 500 km from as early as 30,000 BP.

During the period of intensified aridity in the Last Glacial Maximum, the ways that humans used the arid zones have been debated. Most agree that certain regions such as inland ranges acted as potential refuges, with other less watered environments being abandoned. This thesis is presented in Peter Veth's (1989) *Islands in the Interior*, where people retreated to ranges in the Pilbara, Flinders, Kimberly, and Central Australia, with the remainder of the arid regions being used in more sustained ways in post-LGM climatic regimes. The main dune fields representing some of the more extreme and challenging environments were thought to remain largely unoccupied prior to 5,000 years BP, although some use of sandhill country occurred during the Pleistocene (Smith 1993). The significance of refugia is clear, particularly in the Pleistocene. In building on Veth's paradigm, Smith has recently proposed a model for "cryptic refugia" borrowing from biological studies that suggest that some areas outside of uplands acted as refugia for scattered populations of various species and that a similar model for scattered human groups may be appropriate. If so, populations would need to survive in smaller numbers spread over a former range, relying on pockets of microhabitats (Smith 2013).

European Contact

Following rare, accidental, and deliberate coastal landfalls in the seventeenth and eighteenth centuries, the arrival of European colonists in Australia in the late eighteenth century heralded a dramatic change from a continent of Indigenous hunter-foraging societies with deep-time attachments to local environments (as they were at the time of contact) to a settler nation wherein migrants vastly outnumbered Indigenous peoples. In terms of world history, Australia is colonized "late," with various colonies (mainly penal in nature) around Australia only after 1788 CE.

Unsurprisingly, Australia's massive interior desert regions remained outside the colonization "frontier" until the mid-nineteenth century. Explorers entered (but did not necessarily survive) the arid lands and encountered the peoples already resident there, although many only saw signs of occupation as they passed by

camp and sites. Knowledge was a critical barrier to exploration. Some explorers such as Eyre traveled with Aboriginals, while others such as Canning at times forced Aboriginal people to blaze trails. By the 1860s, explorers had provided knowledge essential for the establishment of isolated outposts strung across Australia's central deserts. These in turn allowed trans-global communication in the form of the Overland Telegraph connecting southeastern Australian colonies to Darwin, then by submarine cable to Singapore and the British Imperial realms. Another very different communication occurred in and around the telegraph repeater stations for each was established in the traditional country of desert communities – this settings provided the location for significant "early historical" observations about Australian Aboriginal society best reflected in the ethnographic observations of Baldwin Spencer and F. J. Gillen. These and other later observations form the foundation from which ethnographic knowledge of desert societies is constructed (see Keen 2003 for further discussion).

From this time onward, Australia's deserts become the setting for increasingly diverse encounters between Indigenous Australians and outsiders (mainly British, but including other ethnicities to create diverse desert societies located well beyond the colonial "frontier"). Nineteenth- and twentieth-century explorations were fuelled by the desire to access land for stock and suitable droving routes (the Canning Stock Route, e.g., cuts across the Western Desert), imaginary interior water sources (the various permutations of "inland seas"), mineral prospectors (such as the announcement by Harold Lassiter in the 1920s of a centralian goldfield), scientific knowledge, and a place beyond the gaze of colonial authority. Exploration led to the establishment of stock-droving routes that crossed the deserts, linked by water and infrastructure, and to various mineral industries, such as Arltunga in the White Range – Central Australia's first official town following gold discovery in 1887 (Holmes 1989).

The early historical period of Australia's desert, from a European perspective, occurred almost

a century after British colonization/invasion. We expect environmental and demographic changes resulting from introduced species to have moved well in advance of colonists (and thus European historical observers). When Europeans arrived, there were few large native fauna and European-introduced species – particularly camels, horses, cows, sheep, goats, dogs, cats, rabbits, and foxes – that had changed the Australian environment dramatically after 1788, resulting in the decline and extinction of many endemic mammalian fauna (Rolls 1984). The ancient Australian soils had never been exposed to hooves, and these animals created havoc (and still continue to) around natural water resources. New plants crowded out native grasses and other plants, at a time when any forms of Indigenous land management – such as the use of fire – were in a state of flux. Few pastoralists looked kindly on the use of fire, seeing it as a threat to stock and the newly installed pastoral infrastructure.

Equally diseases need to be understood – what effect did they have in the early period? Did desert populations plummet, as has been argued by some? The archaeological record is rarely sensitive enough to rigorously measure fluctuations in population in these critical years, given that it is largely a surface record (Campbell 2002). Certainly, the maintenance of long-distance trade networks as observed in Central Australia, for ochre, *pituri* (native tobacco), grindstones, and ceremonies, suggests some robustness in these desert societies following the disruptive arrival of colonists.

We need to distinguish within the various arid and semiarid environments across the continent whether they were colonized by Europeans and other non-Indigenous peoples or not. Many regions were suitable for sheep and cattle pastoralism – other massive desert regions were simply unviable. A gradient of arability emerged from the margins of semiarid regions where stock could be raised, through to those that could not – a situation exacerbated by environmental degradation and fine climatic variation in the more “extreme” or marginal arid environments.

Another significant element of historical period deserts was the introduction of camels

and handlers from various origins in West and South Asia – although widely termed “Afghan” or “Ghan” – a name commemorated in the Alice Springs to Darwin transcontinental railway (Stevens 1989). Little archaeology has yet been done of their camps, places of worship, and work. Equally the arrival of missionaries is a significant archaeological topic, only addressed at a handful of sites such as the Killalpaninna Lutheran Mission on the Birdsville Track (Birmingham & Wilson 2010).

The largest corpus of post-contact archaeological work has been carried out on pastoral sites, some simply interested in pastoralism and others interested in pastoral settings as part of a broader regional process of culture contact. In Lake Eyre, for instance, the archaeological record reveals that Aboriginal people continued to live in and around their estates on vast sheep stations – providing labor, knowledge, and economic security through their seasonal availability. However, only some remained “inside” the pastoral domains, and others remained “outside” as “wild strangers” – at least in the perception of Europeans. Conversely in the northern realms, the demands for work married better with seasonal work demands, with the wet season being a time for the fulfillment of cultural responsibilities (Paterson 2008).

For many today the cultural heritage of deserts reflects pastoralism, remote communities, or survival – or not. Bean (1910) reflected: “There, around Lake Eyre, and over some part of Central Australia you may see them today – deserted homesteads standing out from the desert with the marks of old settlement around them. That is what sheep mean to Australia.” The other record of heritage often overlooked is an Indigenous record, which too has historical components.

To summarize, the archaeological study of post-contact deserts can be divided into (1) rural and regional heritage studies interested in buildings, mine, and infrastructure (Gill & Paterson 2007); (2) culture contact between Aboriginal people and various outsiders (Veth et al. 2008), particularly pastoralists; (3) Indigenous responses to historical contingencies, as reflected in subsistence, settlement, depictive traditions

(especially rock art) (Taçon et al. 2012), and colonial/government authority and labor demands (Paterson 2008); and (4) “longue duree” approaches that articulate historical events into longer time scales, such as Smith’s study of the Cleland Hills (Smith 2005).

In extraordinary events of global relevance, played out locally on patches in the Western Deserts, as late as the 1960s, Aboriginal people who had never seen white people “came out” of the desert and “came into contact” with white Australians for the first time. These events represented the last extreme environments of earth to come into the fold of the wider global community.

Cross-References

- Australian Deserts: Extreme Environments in Archaeology
- Australian Paleoart
- Complex Hunter-Gatherers
- Evolutionary Archaeology: Issues, News, and Reviews
- First Australians: Origins
- Indigenous Archaeologies: Australian Perspective

References

- BALME, J. & K. MORSE. 2006. Shell beads and social behaviour in Pleistocene Australia. *Antiquity* 80: 799-811.
- BALME, J., I. DAVIDSON, J. McDONALD, N. STERN & P. VETH. 2009. Symbolic behaviour and the peopling of the southern arc route to Australia. *Quaternary International* 202: 59-68.
- BEAN, C.E.W. 1910. *On the wool track*. London: A. Rivers.
- BIRMINGHAM, J. & A. WILSON. 2010. Archaeologies of cultural interaction: Wybalenna Settlement and Killalpaninna Mission. *International Journal of Historical Archaeology* 14(1): 15-38.
- CAMPBELL, J. 2002. *Invisible invaders: smallpox and other diseases in Australia 1780-1880*. Carlton South: Melbourne University Press.
- FITZSIMMONS, K.E., T.J. COHEN, P.P. HESSE, J. JANSEN, G.C. NANSON, J.-H. MAY, T.T. BARROWS, D. HABERLAH, A. HILGERS, T. KELLY, J. LARSEN, J. LOMAX & P. TREBLE. 2012. Late Quaternary palaeoenvironmental change in Australian drylands. *Quaternary Science Reviews*. Available at: <http://dx.doi.org/10.1016/j.quascirev.2012.09.007>.
- GILL, N. & A. G. PATERSON. 2007. A work in progress: Aboriginal people and pastoral cultural heritage in Australia, in R. Jones & B. Shaw (ed.) *Loving a sunburned country? Geographies of Australian heritages*: 113-131. Aldershot: Ashgate.
- HOLMES, K. 1989. Arltunga: a minor goldfield in arid Central Australia. *Australian Journal of Historical Archaeology* 7: 43-49.
- HISCOCK, P. 2008. *Archaeology of ancient Australia*. New York: Routledge.
- HISCOCK, P. & L. WALLIS. 2005. Pleistocene settlement of deserts from an Australian perspective, in P. Veth, M.A. Smith & P. Hiscock (ed.) *Desert peoples archaeological perspectives*: 34-57. Massachusetts: Blackwell Publishing.
- KEEN, I. 2003. Aboriginal economy and society at the threshold of colonisation: a comparative study. *Before Farming* 3(2): 1-24.
- MARKGRAF, V., J.R. DODSON, A.P. KERSHAW, S.M. MCGLONE & N. NICHOLLS. 1992. Evolution of late Pleistocene and Holocene climates in the circum-south Pacific land areas. *Climate Dynamics* 6: 193-211.
- PATERSON, A. G. 2008. *The lost legions: culture contact in colonial Australia* (Indigenous Archaeologies series). Walnut Creek (CA): AltaMira Press.
- PETHERICK, L.M., P.T. MOSS & H.A. MCGOWAN. 2011. Climatic and environmental variability during the termination of the Last Glacial Stage in coastal eastern Australia: a review. *Australian Journal of Earth Sciences: An International Geoscience Journal of the Geological Society of Australia* 58(6): 563-77.
- ROLLS, E.C. 1984. *They all ran wild: the story of pests on the land in Australia*. Sydney: Angus and Robertson.
- SHULMEISTER, J. 1999. Australasian evidence for mid-Holocene climate change implies precessional control of Walker circulation in the Pacific. *Quaternary International* 57/58: 81-91.
- SMITH, M.A. 1993. Biogeography, human ecology and prehistory in the Sandridge Deserts. *Australian Archaeology* 37: 35-50.
- 2005. *Peopling the Cleland Hills: Aboriginal history in western Central Australia 1850-1980*. Canberra: Aboriginal History Inc.
- 2013. *The archaeology of Australia's deserts*. New York: Cambridge University Press.
- SMITH, M.A. & J. ROSS. 2008. What happened at 1500-1000 BP in Central Australia? Timing, impact and archaeological signatures. *The Holocene* 18(3): 387-96.
- SMITH, M.A., A.N. WILLIAMS, C.S.M. TURNEY & M. CUPPER. 2008. Human environment interactions in Australian drylands: exploratory time-series analysis of archaeological records. *Holocene* 18(3): 389-401.
- STEVENS, C. 1989. *Tin mosques & ghantowns: a history of Afghan camel drivers in Australia*. Alice Springs: Paul Fitzsimmons.

- STURMAN, A. & N. TAPPER. 1996. *The weather and climate of Australia and New Zealand*. Oxford: Oxford University Press.
- TAÇON, P. S. C., J. ROSS, A. G. PATERSON & S. MAY. 2012. Picturing change and changing pictures: contact period rock art of Australia, in J. McDonald & P. Veth (ed.) *Companion to rock art*: 420-36. Malden: Wiley-Blackwell.
- TURNER, C.S.M., M.I. BIRD, L.K. FIFIELD, R.G. ROBERTS, M. SMITH, C.E. DORTCH, R. GRUN, E. LAWSON, L.K. AYLIFFE, G.H. MILLER, J. DORTCH & R.G. CRESSWELL. 2001. Early human occupation at Devil's Lair, southwestern Australia 50,000 years ago. *Quaternary Research* 55: 3-13.
- VETH, P. 1989. Islands in the interior: a model for the colonisation of Australia's arid zone. *Archaeology in Oceania* 24: 81-92.
- 2005. Cycles of aridity and human mobility: risk minimisation among late Pleistocene foragers of the Western Desert, Australia, in P. Veth, M.A. Smith & P. Hiscock (ed.) *Desert peoples archaeological perspectives*: 100-15. Massachusetts: Blackwell Publishing.
- VETH, P., P. SUTTON & M. NEALE. 2008. *Strangers on the shore: early coastal contact in Australia*. Canberra: National Museum of Australia Press.
- VETH, P., M. SMITH, J. BOWLER, K. FITZSIMMONS, A.N. WILLIAMS & P. HISCOCK. 2009. Excavations at Parnkupirti, Lake Gregory, Great Sandy Desert: OSL Ag for occupation before the Last Glacial Maximum. *Australian Archaeology* 69: 1-10.
- VETH, P., N. STERN, J. BALME, J. McDONALD & I. DAVIDSON. 2011. The role of information exchange in the colonization of Sahul, in R. Whallon, W.A. Lovis & R.K. Hitchcock (ed.) *Information and its role in hunter-gatherer bands. Ideas, debates, and perspectives* 5: 209-20. Los Angeles: Cotsen Institute of Archaeology Press.
- WILLIAMS, A.N. 2012. The use of summed radiocarbon probability distributions in archaeology: a review of methods. *Journal of Archaeological Science* 39: 578-89.
- WILLIAMS, A.N., S. ULM, I. GOODWIN & M. SMITH. 2010. Hunter-gatherer response to late Holocene climatic variability in northern and Central Australia. *Journal of Quaternary Science* 25(6): 831-8.
- WILLIAMS, M., E. COOK, S. VAN DER KAARS, T.T. BARROWS, J. SHULMEISTER & P. KERSHAW. 2009. Glacial and deglacial climatic patterns in Australia and surrounding regions from 35000 to 10000 years ago reconstructed from terrestrial and near-shore proxy data. *Quaternary Science Reviews* 28: 2398-419.

Further Reading

- MAGEE, J., G.H. MILLER, N.A. SPOONER & D. QUESTIAUX. 2004. Continuous 150 k.y. monsoon record from Lake Eyre, Australia: insolation-forcing implications and unexpected Holocene failure. *Geology* 32(10): 885-8.
- PATERSON, A. G., N. GILL & M. KENNEDY. 2003. An archaeology of historical reality? A case study of the recent past. *Australian Archaeology* 57: 82-9.

Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS): Its Role in Australian Archaeology

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Introduction and Definition

The statutory authority of the Australian Commonwealth (federal) government known as the "Australian Institute of Aboriginal Studies" from 1964 to 1989 and "The Australian Institute of Aboriginal and Torres Strait Islander Studies" (1989 to present) has as its primary function support of research into Indigenous Australia (Anon. 1964, 1989). Archaeology was a central focus of the Institute from its inception. The 1961 "Conference on Aboriginal Studies" held under the auspices of the Social Science Research Council that led to the founding of the Institute heard presentations by representatives of each of the disciplines comprising the then fields of Australian Aboriginal Studies: anthropology, human biology, linguistics, prehistory and material culture, and strong arguments for a national research center (Stanner & Sheils 1963; Mulvaney 1963: 33-51; Horton 1986: 83). The Institute's first two principals (chief executive officers), Fred McCarthy (Fig. 1) and Peter Ucko (Figs. 2 and 3), were archaeologists, and chairs of the Institute's Council were involved in prehistoric archaeology Professor Neil W.G. Macintosh (1906-1977), Professor of Anatomy at the University of Sydney and a foundation member of AIAS, between 1966 and 1974; and Professor D. John Mulvaney AO CMG (1925-), known as the "father of Australian archaeology," during the years 1982 and 1984 (Figs. 4 and 5). Most of the first generation of Australian academic archaeologists was involved with the Institute in at least its first decade, guiding not only its activities but also the development in Australia of the discipline itself.