

University of Wollongong

## Research Online

---

Faculty of Science, Medicine and Health -  
Papers: part A

Faculty of Science, Medicine and Health

---

2004

### Comparative records of occupation in the Keep River region of the eastern Kimberley, northwestern Australia

Ingrid Ward  
*University of Wollongong*

Follow this and additional works at: <https://ro.uow.edu.au/smhpapers>



Part of the [Medicine and Health Sciences Commons](#), and the [Social and Behavioral Sciences Commons](#)

---

#### Recommended Citation

Ward, Ingrid, "Comparative records of occupation in the Keep River region of the eastern Kimberley, northwestern Australia" (2004). *Faculty of Science, Medicine and Health - Papers: part A*. 1897.  
<https://ro.uow.edu.au/smhpapers/1897>

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: [research-pubs@uow.edu.au](mailto:research-pubs@uow.edu.au)

---

## Comparative records of occupation in the Keep River region of the eastern Kimberley, northwestern Australia

### Abstract

This paper considers the record of occupation in the Keep River region of the eastern Kimberley, and whether archaeological records are equally preserved within as well as between regions. Luminescence dating, radiocarbon dating and archaeological evidence from eight rock shelter sequences provide only late Holocene (5 - 0 ky BP) occupation sequences, whereas luminescence dating and archaeological evidence for three sand-sheet sequences indicate occupation dating to 18 ky BP. Given that rock shelters and sand sheet excavations can produce such different chronologies, it is questioned to what extent the representative records for the eastern Kimberley, and the adjacent western Kimberley, Victoria River District and Arnhem Land regions can be compared. It is also argued that in the absence of comparative non-occupation chronostratigraphy, particularly of rock shelters, it remains unclear whether apparent Holocene intensification is a product of cultural change or of research and preservation.

### Keywords

australia, northwestern, kimberley, comparative, eastern, records, region, river, keep, occupation

### Disciplines

Medicine and Health Sciences | Social and Behavioral Sciences

### Publication Details

Ward, I. (2004). Comparative records of occupation in the Keep River region of the eastern Kimberley, northwestern Australia. *Australian Archaeology*, 59 1-9.

# Comparative records of occupation in the Keep River region of the eastern Kimberley, northwestern Australia

Ingrid Ward

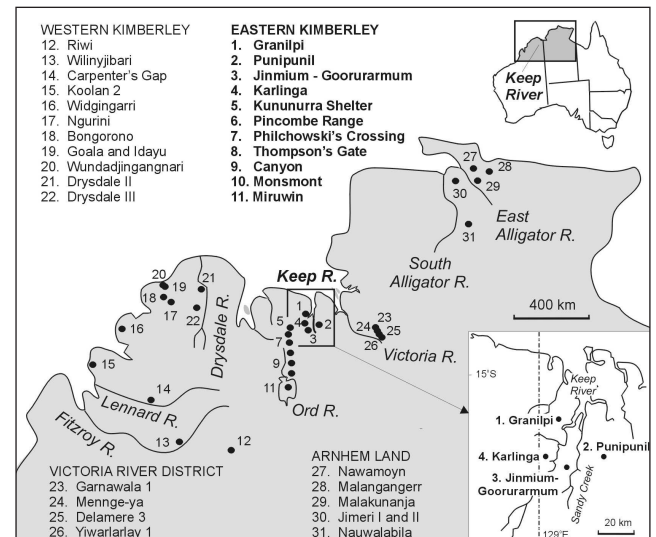
## Abstract

This paper considers the record of occupation in the Keep River region of the eastern Kimberley, and whether archaeological records are equally preserved *within* as well as *between* regions. Luminescence dating, radiocarbon dating and archaeological evidence from eight rock shelter sequences provide only late Holocene (5 – 0 ky BP) occupation sequences, whereas luminescence dating and archaeological evidence for three sand-sheet sequences indicate occupation dating to 18 ky BP. Given that rock shelters and sand sheet excavations can produce such different chronologies, it is questioned to what extent the representative records for the eastern Kimberley, and the adjacent western Kimberley, Victoria River District and Arnhem Land regions can be compared. It is also argued that in the absence of comparative non-occupation chronostratigraphy, particularly of rock shelters, it remains unclear whether apparent Holocene intensification is a product of cultural change or of research and preservation.

## Introduction

The cultural province of the Keep River is located in the eastern Kimberley (Fig. 1), adjacent to and possibly related to the cultural provinces of the western Kimberley and Victoria River District (Taçon et al. 1999) and Arnhem Land (Lewis 1988). The relative age of occupation in the Keep River region compared to these adjacent cultural provinces remains in contention (Fullagar et al. 1996; Roberts et al. 1997; Watchman et al. 2000). The earliest evidence for occupation is considered to be in Arnhem Land (Mulvaney and Kamminga 1999), although the previous determined age of ~ 60 ky BP (Roberts et al. 1998b) is now being questioned and a later age of ~ 45 ky BP proposed (O'Connell and Allen 2004). In the western and eastern Kimberley, the earliest evidence of occupation is ~ 40 ky BP (O'Connor 1995) and ~ 20 ky BP respectively (Dortch and Roberts 1996). However, before making any comparisons regarding occupation *between* regions, it is important to consider whether archaeological time periods are equally preserved *within* regions (Waters and Khuen 1996), otherwise comparisons between regions may only be random.

This paper compares the occupation record in sedimentary sequences from five rock shelters with that of three sand sheets within the region of the Keep River. Sand sheets are the physical link between the escarpments and rock shelters, and research is concentrated at five sites, known in aboriginal tradition as Jinmium, Goorurarmum, Punipunil, Granilpi and Karlinga (Fig. 1). Geochronological determinations derive from recent (Ward 2003;



**Figure 1** Location of major archaeological excavation sites in the eastern Kimberley (bold), western Kimberley and Arnhem Land, and in the Keep River region (inset).

Ward et al. 2005) and previously published research (Fullagar et al. 1996; Head and Fullagar 1997; Atchison 2000), and include radiocarbon, thermo-luminescence (TL), and optically-stimulated luminescence (OSL) dating. Readers are referred to these earlier publications for full site descriptions, and a discussion of the sedimentary and archaeological records is provided in a separate publication (Ward et al. 2004). Current data from the Keep River are integrated into the existing record of occupation in the eastern Kimberley and are considered alongside the representative occupation records for the adjacent regions of western Kimberley and Arnhem Land.

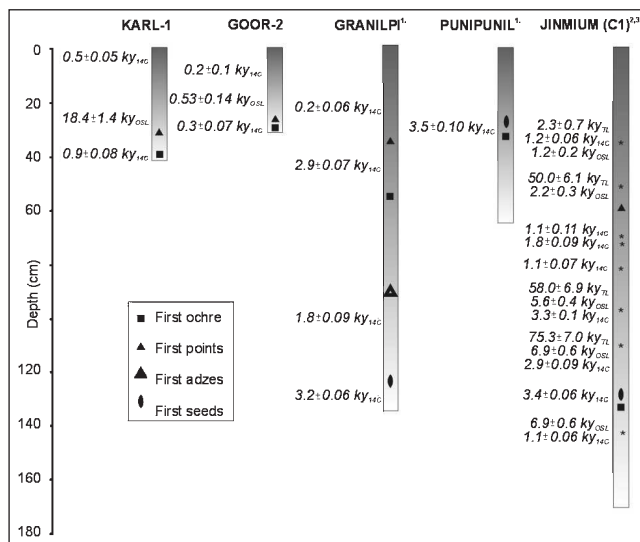
## Review of archaeological excavations in the Keep River region

Typically, the sedimentary stratigraphy of sand sheets and rock shelters comprise loose charcoal-enriched surface sands, overlying slightly more compact sands, which themselves overlie rubble and/or a bedrock base. Cultural materials include flaked and stone points, charcoal, processed seeds, ochre, bone, and glass. Stone points from the Kimberley region have been dated to ~ 3 ky BP (Attenbrow et al. 1995; Fullagar et al. 1996: 764). Full details of chronometric, sedimentary and archaeological records for the Jinmium, Granilpi and Punipunil excavations can be found in Fullagar et al. (1996), Atchison, (2000) and Atchison et al. (in prep.), and for the Goorurarmum and Karlinga excavations in Ward (2003), Ward et al. (2004, 2005).

The Karlinga (Karl-1) rock shelter excavation site is located at the base of a sandstone cliff, and sheltered behind several large boulders. OSL dating of sediments provides an

School of Geosciences, University of Wollongong, Wollongong, NSW 2522, Australia

Correspondence address: 17 Brickfield Cottages, Somerleyton, NR32 5QW, Suffolk, U.K. Email: ingridward@nasct.net



**Figure 2** Ages (ky BP) and archaeological evidence from five rock-shelter excavations from past and present research in the Keep River region, including Karlinga (Karl-1), Goorurarmum (Goor-2), Punipunil (PP1), Granilpi (G1) (Atchison 2000, Atchison et al. in prep.), and Jinmium (C1) (Fullagar et al. 1996; Roberts et al. 1998a; Atchison et al. in prep.). The OSL ages for the Jinmium profile represent central age estimates from single-grain dating (from Roberts et al. 1998a). The presence of uniface and biface stone points all occur in upper Holocene levels.

age of  $18.4 \pm 1.4$  ky BP at a depth of 27 cm (Fig. 2). However, this estimate is not considered to represent an occupation age because, like the sediments from the Jinmium rock shelter (Roberts et al. 1999), the sands probably include 'saturated' quartz derived from the slow disintegration of the overlying and surrounding bedrock (for more details see Ward 2003; Ward et al. 2004). The 18.5 ky BP age is also markedly inconsistent with: (i) radiocarbon estimates younger than 1 ky BP from charcoal samples from the same sediments, (ii) with other luminescence and radiocarbon ages for rock shelter excavations undertaken in the Keep River region, and (iii) with the presence of flaked stone and Kimberley points (Fig. 2).

The Karlinga (Karl-3) sand sheet excavation is located approximately 500 m from the rock shelter site. The sediments at this site are unaffected by bedrock contamination as no contact was made with the underlying bedrock. OSL dating provides an age of  $18 \pm 0.6$  ky BP at 240 cm depth (Fig. 3), and similar TL age estimates were determined for the surrounding sediments (see Ward 2003, Ward et al. in review), representing a minimum age for the beginning of sand sheet formation (Ward 2003). The highest density of stone artefacts, including stone points, occurs immediately above and below two cobble layers (Fig. 3), dated by OSL to around 2.5 ky BP and 9 ky BP respectively.

The Goorurarmum (Goor-2) excavation site is located in an elevated rock shelter, and the adjacent sand sheet excavation (Goor-1) is approximately 20 m in front of the shelter. The sediments within the rock shelter provide a similar OSL age of  $0.5 \pm 0.14$  ky BP and radiocarbon age of

$0.3 \pm 0.07$  ky BP. These recent age estimates are younger than that indicated from the presence of stone points at the base of the profile (Fig. 2), indicating that either the points or the older sediments which contained them have been moved or reworked. The lowermost sediments of the adjacent sand sheets are significantly older, dated by TL to  $14.3 \text{ ky} \pm 0.4 \text{ ky BP}$  at 220 cm depth (Fig. 3). These sediments overlie an indurated or bedrock horizon which may represent an LGM surface. Secondary mixing is indicated from the inversion between the OSL age of  $4.3 \pm 0.1$  ky BP at 180 cm and the TL age of  $6.1 \pm 0.1$  ky BP at 155 cm (Fig. 3), assuming no error in the dates. The greatest density in artefacts, including charcoal, stone points, and bone occurs in the upper metre of the sediment sequence (Ward 2003).

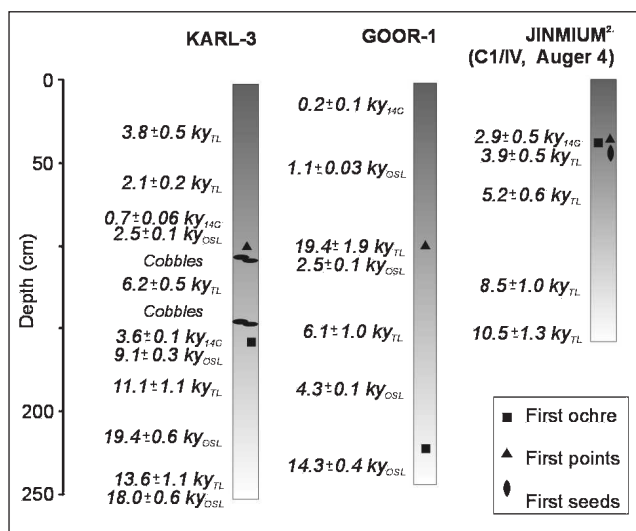
The Granilpi excavation site is within a cluster of boulders on the northwestern side of a large sandstone outcrop which displays extensive rock art (Tacon et al. 1997), whilst Punipunil is a long, narrow rock shelter lying within a sheltered gorge (Atchison 2000). Radiocarbon dating of fruit-tree seeds from both the Granilpi and Punipunil rock shelter excavations (Atchison 2000) provides an early to mid-Holocene age for these sequences (Fig. 2). In addition to the fruit seeds, excavation pits contain grinding stones, flaked quartz, Kimberley points, bone, ochre, shell and glass (Atchison et al. in prep.). There are no dated sand sheet records adjacent to the rock shelter excavation.

The Jinmium (C1) rock shelter excavation occurs at the base of an exposed sandstone boulder, 10 m from which is located the sand sheet (C1/IV) excavation. Figure 2 gives radiocarbon and TL age estimates (Fullagar et al. 1996), and single-grain, central-age OSL age estimates (Roberts et al. 1998b). The young sediment chronology provided by OSL and radiocarbon dating is supported by the seed and stone artefact chronology (Atchison 2000; Atchison et al. in prep.), despite any apparent disturbance or contamination (Roberts et al. 1998b). Unlike the rock shelter sediments, the published chronology for the Jinmium sand sheet excavation (Fullagar et al. 1996) has never been revised. Recent dating of sand sheet sediments between Jinmium and Goorurarmum provides a TL age of  $\sim 76$  ky BP at 6 m (Ward 2003; Ward et al. 2005), lending support to the TL chronology determined by Fullagar et al. (1996) which provided an age of  $103 \pm 14$  ky BP at 5 m depth near the Jinmium site. Fullagar et al. (1996) note that stone artefacts are found throughout the sand sheet deposit, but the initial presence of stone points, ochre and seed artefacts is dated to around 2.9 – 3.9 ky BP (Fig. 3).

## Discussion

### Comparison of rock shelter and sand sheet sequences

Disregarding the 18.5 ky BP estimate for the Karlinga rock shelter and accepting the young Holocene chronology for Jinmium, the sedimentary sequences, the sedimentary sequences of rock shelters in the Keep River region are all mid- to late-Holocene (7 – 0 ky BP) in age (Fig. 2). In contrast, the adjacent sand sheets comprise sediments and associated cultural sequences that are much older (Fig. 3), and provide a possible record of human occupation extending back to 18 ky BP. Furthermore, the sand-sheet excavations provide greater vertical accumulation of Holocene sediments and archaeological deposits. Thus, rather than reflecting any absence of earlier occupation



**Figure 3** Ages (ky BP) and archaeological evidence from the three sand sheet excavations with occupation records in the Keep River region, including Karlinga (Karl-3), Goorurarmum (Goor-1) (this study) and Jinmium (Auger 4) (Fullagar et al. 1996). As in the rock shelters, uniface and biface stone points occur in upper Holocene levels.

within the rock shelters, it appears likely that the geomorphology of these rock shelters is inefficient for the long-term accumulation and storage of sediments and archaeological material compared to the adjacent sand sheets.

The presence of deposits deeper and older deposits outside compared to within the rock shelters has previously been noted at Native Well I, Queensland, with respective ages of 6.1 ky BP and 11.0 ky BP (Morwood 1981). Unfortunately, in this and in a number of other excavations which have extended outwards beyond the dripline of the rock shelters there has generally been minimal comparison of cultural deposits (e.g. Flood 1970; Smith 1989) and of sediments and chronology (e.g. Jones and Johnson 1985; Allen and Barton 1989; Morwood et al. 1995) between the rock shelter and outside areas. Although enclosed rock shelters may offer greater potential for preservation of older sequences (Lourandos and David 1998), the excavation records for the Keep River region indicate that greater preservation of older sequences may sometimes occur in open sites. Here, the rock shelters with young ages have Late Pleistocene ages for cultural deposits in the immediately adjacent sand sheet. There are examples of Pleistocene age sequences within rock shelters, including Narrabulgin (David 1993), Carpenter's Gap (O'Connor 1995, 1996) and Riwi (Balme 2000), but interpretation of these older sequences is limited by the absence of a wider contextual chronostratigraphy.

#### ***Representative occupation records for the eastern Kimberley, western Kimberley, and Arnhem Land***

Given that excavations of rock shelters and sand sheets can produce such different results, it is worth re-evaluating the representative occupation records for the eastern Kimberley, and the adjacent western Kimberley and Arnhem Land regions. Figures 4a – d show the occupation sequence for the (a) eastern Kimberley, (b) western Kimberley, (c) Victoria River District and (d) Arnhem Land

regions of northwestern Australia, based on previously published radiocarbon dates (<sup>14</sup>C dates are uncorrected) and luminescence dates. It is noted that much of the published data lack high-quality stratigraphic information and  $\delta^{13}\text{C}$  values as a guide to the material being dated. Here, the important consideration in the regional chronological comparisons is the extent to which the datasets are comparable. Those interested in the quality of the dating results are referred elsewhere (for reviews see Frankel 1990; Allen 1994; Roberts and Jones 2001).

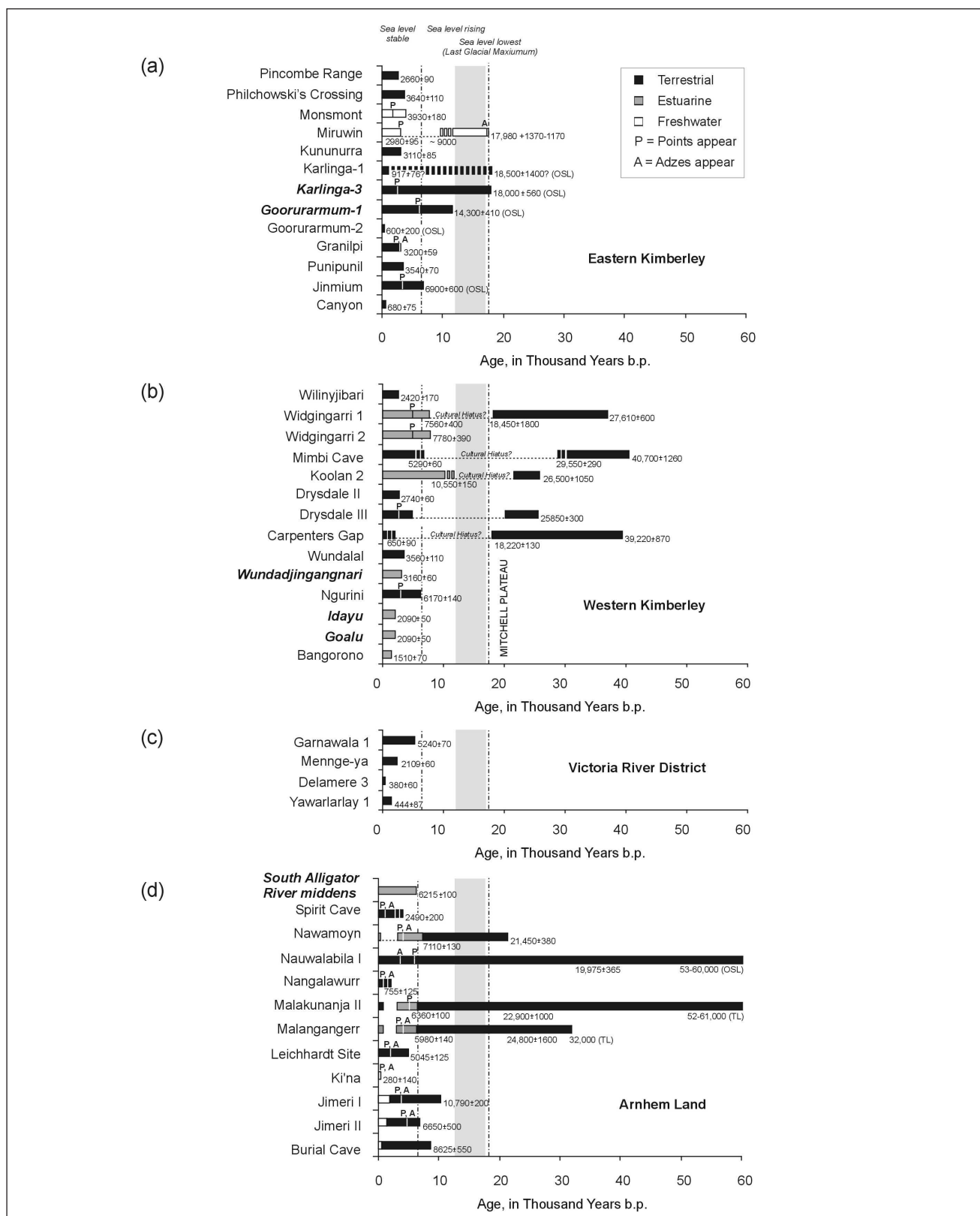
In the Keep River and surrounding region over 80 % of published archaeological excavations have been rock shelter sites (Fig. 4a), and contain a freshwater or terrestrial record. Of these sites, most are late Holocene in age with earliest evidence of occupation dated to 4 - 3.5 ky BP. All sites in the Victoria River District are rock shelters and all are Holocene in age (Fig. 4c). In Arnhem Land, the vast majority of archaeological investigations have also been in rock shelters (Tacon and Brockwell 1995), and these apparently indicate an accelerated increase in site numbers from the terminal Pleistocene (Morwood and Hobbs 1995).

In the western Kimberley, only Wundadjingangnari, Idayu and Goalu are open midden sites, and the remaining 11 archaeological sites are rock shelters containing terrestrial and estuarine records (Fig. 4b). The three midden sites are all located in the Mitchell Plateau (Fig. 1) where the occupation record is entirely Holocene (Fig. 4b). Similarly, for coastal midden sites along the South Alligator River, most are younger than 6 yr BP in age (Woodroffe et al. 1988). However, it is unclear whether the greater abundance of these mid- and late-Holocene middens indicate change in human occupation or preferential preservation of the younger material following stabilisation of sea-level to current levels (Woodroffe et al. 1988: 101) (see also discussion below). In the eastern Kimberley archaeological record (Fig. 4a), there are no published dated midden sites or evidence of a marine economy.

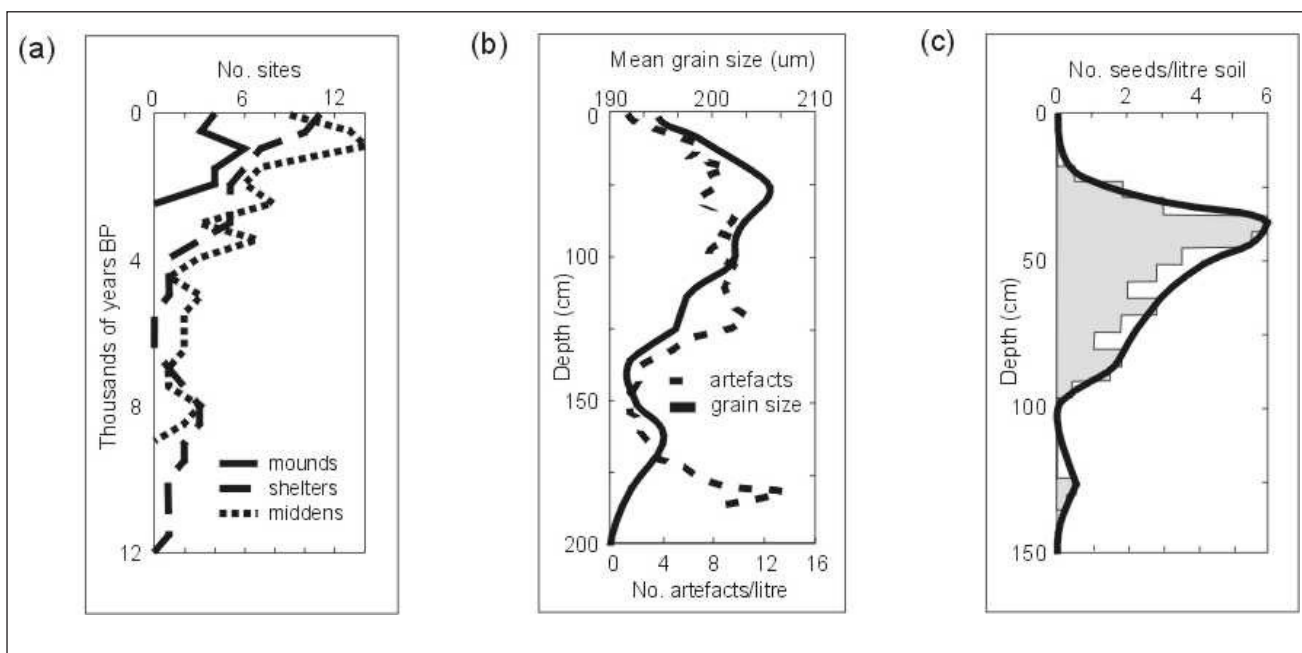
In other parts of the western Kimberley the occupation sequence extends into the Pleistocene, but comprises a period from ~ 17 to 13 ky BP (shown as a grey band on Figs. 4a – d) which has been regarded as a cultural hiatus (Veth 1995; O'Connor et al. 1999). Confusingly, the record at Carpenter's Gap apparently provides evidence for a continuous cultural presence for the past 40 ky BP (McConnell and O'Connor 1997; Balme 2000) despite the hiatus above the LGM levels. It remains unclear whether each of the major chronological hiatuses documented in each of these excavations (Fig. 4b) actually represent a 'cultural hiatus' during which time the site was seldom used and little sediment accumulated, or represent a natural hiatus in which any late Pleistocene-early Holocene sediments were removed by geomorphic processes (Wallis 2001: 105).

In any case, it is apparent that in all regions of northwestern Australia most excavated sites have been rock shelters and the majority of these are Holocene in age. Whether the resulting records are regionally comparable depends primarily on identifying the natural processes (e.g. physical conditions) or cultural process (e.g. population movements) which may explain the temporal distribution patterns (e.g. Feathers 1997; Parkington 1989; Ward and Larcombe 2003). In Arnhem Land, for example, Woodroffe et al. (1988) documented how the geomorphological

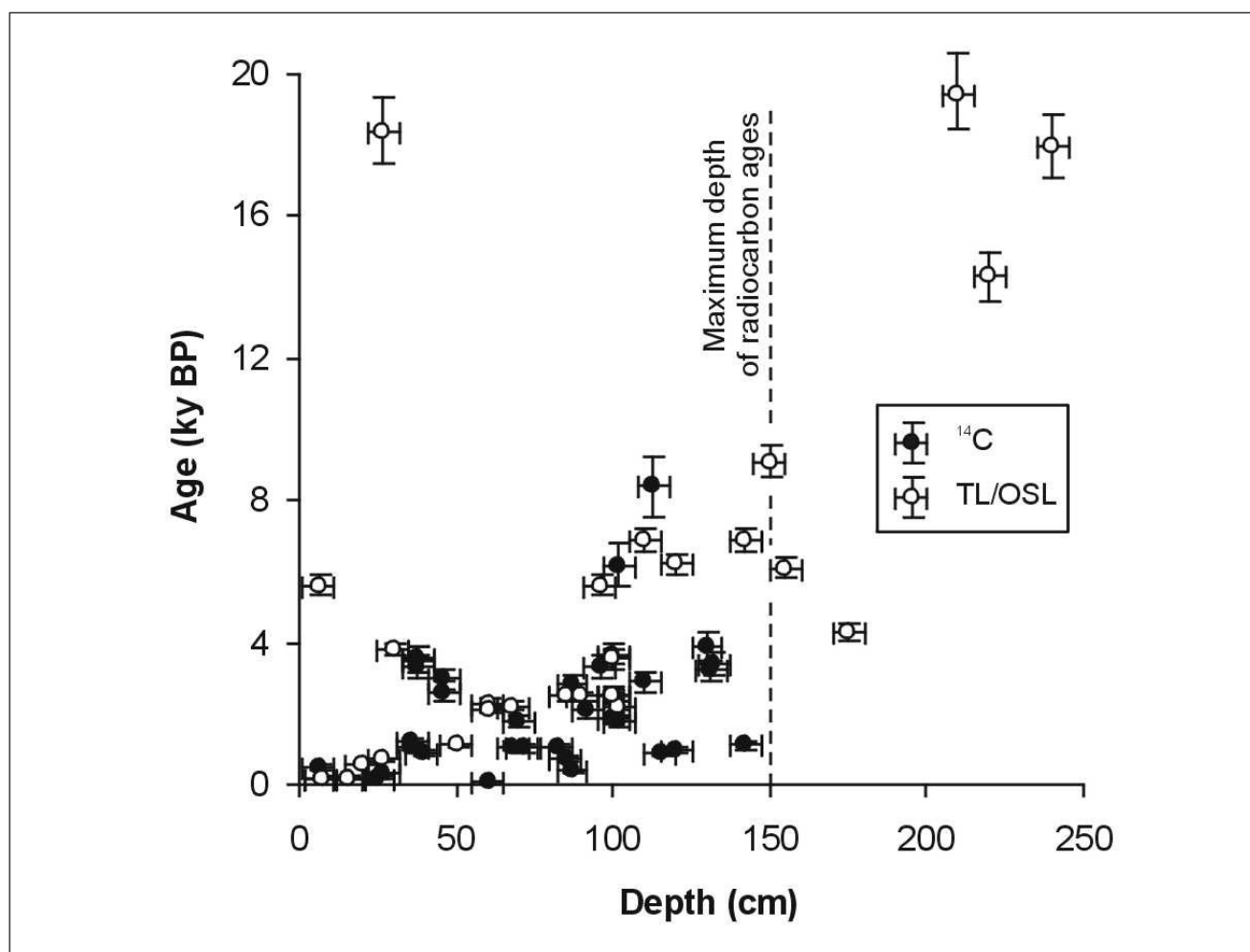




**Figure 4** Dated archaeological sites in the (a) eastern Kimberley region (data from Dortch and Roberts 1996; Roberts et al. 1998a; Atchison 2000; Ward 2003), (b) western Kimberley (data from Balme 2000; Harrison and Frink 2000; Morwood and Hobbs 1995; Veth 1995; O'Connor 1996 and McConnell and O'Connor 1997), (c) Victoria River District (David et al. 1990; McNiven et al. 1992); and (d) western Arnhem Land (Schrire 1982; Woodroffe et al. 1988; Roberts et al. 1994; Morwood and Hobbs 1995; Veth 1995 and Roberts 1997). Radiocarbon determinations for archaeological sites throughout north-west Australia are listed in Veth (1995: 736-7). All ages are uncalibrated  $^{14}\text{C}$  ages, or are marked by subscript as luminescence age (TL or OSL). Chronological gaps (stippled line) are defined as a cultural hiatus according to the authors, or as a question mark if unknown. The grey band marks the period from ~17 to 13 ky BP where, according to Veth (1995: 744), no dates have been registered from northwest Australia. The dated introduction of stone points (P) and adzes (A) are marked. Listed sand sheet and midden sites are italicised.



**Figure 5** Depth profile of (a) mean grain size of well-sorted sands and artefact (2 – 4 mm) numbers in the Goorurarmum sand sheet excavation (from Ward 2003), (b) processed fruit seed numbers in the Jinmium (C1/III) rock-shelter excavation (from Atchison 2000), and (c) comparison of arch-aeological sites of southwestern Victoria and southeastern Australia for the past 12 ky BP (from Lourandos 1997: 225, his Figure 6.17). Are these trends a result of cultural or natural processes?



**Figure 6** Comparison of luminescence ages and radiocarbon ages (including Atchison 2000; Roberts et al. 1998a) for archaeological sites in the Keep River region over the past 20 ky BP. Radiocarbon ages do not extend beyond 150 cm, which equates to a maximum age of 8 ky BP. Older ages may be found where water tables are lower.

development in association with sea-level rise of the South Alligator River had influenced the distribution and preservation of shell middens, with the oldest  $^{14}\text{C}$  dated to  $6215 \pm 100$  y BP (Fig. 4c). It is possible that a similar geomorphological history may account for the similar temporal distribution of midden records in the western Kimberley (Fig. 4b). More generally, the limited resolution of archaeological and environmental records in the unconsolidated sandy profiles typical of northern Australia often result in an approach in which temporal distribution patterns are used to identify cultural processes (Parkington 1989; Holdaway and Porch 1995).

In order to make comparisons between site types it is first necessary to normalise them to equivalent non-occupied sites or some other measure of frequency or common datum. Comparison between different sites may only be possible if the associated *processes* which result in those shared patterns can be demonstrated (see Ward and Larcombe 2003). Lourandos (1997: 225) compares three different types of archaeological site (rock shelters, shell middens and earth mounds) of southwestern Victoria and southeastern Australia for the past 12 ky BP (Fig. 5a) and argues for a significant increase in site use and establishment since 3.5 ky BP. However, in the absence of normalisation, the frequency of sites may reflect the greater preservation of younger (and probably shallower) site assemblages. In other words, the trends shown by the different sites types can also be explained by natural rather than cultural processes and these are not necessarily the same for each site. Lourandos (1997: 225) argues that prior to the terminal Pleistocene when sites first become visible, the climate had been drier, landscapes open and semi-arid, resources dispersed and Aboriginal populations thus relatively more dispersed. Inevitably, there would be poorer preservation of these earlier sites. Lourandos (1997: 226) also argues that the appearance and increase in earth mounds in association with wetlands since 2.5 ky BP reflects more intensive site use. However, it may also indicate that earth mounds may not survive longer than 2.5 ky BP in such environments because in his words *no equivalent sites existed in prior times*.

In considering the temporal distribution of archaeological sites, it should first be questioned whether the same patterns exist in both occupied and equivalent unoccupied sites. For example, it may be questioned whether the absence of Pleistocene age sediments in occupied rock shelters is also observed in rock shelters where there is no evidence of occupation. In some cases, it may be possible to compare equivalent sites, e.g. animal or bird-midden sites and man-made midden sites. Such questions may require closer co-operation among sedimentologists and archaeologists during planning, excavation, and interpretative stages (e.g. Farrand 2001).

### **The Holocene record and Intensification**

Regionally, the mid- to late-Holocene period is generally regarded as one of increased cultural change indicated by alterations in stone artefacts (new types), greater use of processed plants, development of regional art styles and increased occupation of older sites (Hiscock 1984). In the Keep River record, *qualitative* changes can be observed in the nature of processing of plants (e.g. Atchison 2000; Atchison et al. in prep.) and reduction of stone tools (Fullagar et al. 1996; Boer-Mah 2002). However, it is

uncertain whether the apparent *quantitative* changes in the number of archaeological sites and deposits in the Holocene actually are products of one or more of (i) cultural change, (ii) research and/or (iii) preferential preservation.

In terms of cultural change, previous research in the Keep River region indicates an increase in the number of sites preserving rock art from about 4 ky BP (Watchman et al. 2000; Ouzman et al. 2002), the introduction of stone points around 3 ky BP (Fullagar et al. 1996: 764; Atchison 2000; Boer-Mah 2002: 38) and archaeobotanical evidence of fruit-seed processing from at least 3.5 ky BP (Atchison 2000). Palaeoecological evidence also indicates that wet and dry rainforest experienced significant human alteration in the late Holocene (5 - 0 ky BP) (Head 1996). Although there are thus clear indications of increased cultural change, there are also natural processes which may have influenced these records. For example, in some sand sheet profiles in the Keep River region the mean grain size decreases through illuviation as finer material is concentrated in deeper horizons (Fig. 5b). That there is a similar pattern with depth of mean grain size and artefact numbers (2 - 4 mm fraction) in the same profile (Fig. 5b) may indicate a similar redistribution of cultural material. Van Nest (2002) has also observed a similar pattern in artefact distribution and bioturbation in a sandy deposits in western Illinois. Indeed, Michie (1983: 23) has argued that the formation of the archaeological record in some sandy areas is wholly attributable to a dynamic system of bioturbation and gravity (see also Leigh 2001). These results demonstrate the need to distinguish process-related from product-related attributes of a site, and to differentiate cultural from natural processes (see also Waters and Kuehn 1996; Ward and Larcombe 2003).

In terms of research, the bias towards late Holocene timescales has been indicated from a greater representation of rock shelters sites than open sites in the published records (see Smith and Sharp 1993; Ulm in press). Similarly, for South Africa, Parkington (1989) considered that the extreme bias in the distribution of radiocarbon dates towards cave or rock shelters primarily represented changing patterns of cave use rather than of prehistoric settlement in general. As indicated by Parkington (1989: 215), in the case of thorough regional surveys, a chronological database can be made more relevant by considering the set of open-site assemblages. A chronostratigraphic survey of unoccupied rock shelters within the regional area of interest would also provide an indication whether the observed patterns in the occupied rock shelters were representative of natural or cultural processes.

In terms of preservation, the extreme weathering of semi-arid monsoonal climates will decrease preservation potential of artefacts and bias a record in a sedimentary sequence in favour of younger material. In the Jinnium rock-shelter excavation, for example, fruit seeds were noticeably weathered in the uppermost sediments and their number declined in depths below 40 cm (Fig. 5c) indicating that this record was influenced more by preservation factors rather than cultural processes (Atchison et al., in prep.). In the Keep River region, the lack of radiocarbon ages beyond depths greater than 150 cm (Fig. 6) most likely reflects *in situ* limited organic preservation due to water table changes. At Nauwalabila, Fifield et al. (2001) also observed that radiometric  $^{14}\text{C}$  ages were unreliable beyond this depth,



coincident from the appearance of pisoliths of a prior fluctuating water table. Thus there may be past or present environmental factors which limit the age-depth range of radiocarbon dates, which in some cases may be avoided by choosing sites at higher elevations.

Variations in sedimentation rate, whether due to cultural or natural processes, are an important consideration when evaluating the intensity of site use as a function of the density of artefacts or fauna (Farrand 2001: 547). A major factor in the preferential preservation of Holocene records in the Keep River region is that of increasing sedimentation rates on sand sheets from less than 10 cm.ky-1 in the late Pleistocene to over 20 cm.ky-1 in the Holocene (Ward 2003; Ward et al. 2004). At a similar site in Nauwalabila I, Arnhem Land, Hope et al. (1995) also noted a progressive increase in sediment accumulation, from less than 1 cm.ky-1 in the mid-Pleistocene to about 10 cm.ky-1 in the late Pleistocene-early Holocene, before apparently ceasing completely in the past 2000 years. Higher sediment accumulation rates may reduce exposure time and increase preservation potential, which may explain increased artefact accumulation rates per unit time (see also Farrand 2001; Ward and Larcombe 2003).

In summary, the predominantly late Holocene record of occupation in the eastern Kimberley region may reflect real cultural changes, but before any interpretations of human behaviour can be addressed, the effects of research bias towards rock shelter sites and the limitations imposed by preferential preservation in semi-arid sandy environments need to be considered further. Whilst regional comparisons may be valid between rock-shelter sites and over Holocene time periods, it is unknown whether there is a comparable record of late Pleistocene occupation in the sand sheets to that which is preserved in the Keep River region. These issues of sampling and taphonomy are not limited to northwestern Australia, but also exist in north Queensland (Ulm in press), and in South Africa (Parkinson 1989) and North America (Marshall 2001). Thus, it remains important to continue to re-examination regional datasets and decipher the relationship between absence of evidence and evidence of absence in the preserved archaeological record.

## Conclusions

In the Keep River region, there is evidence of occupation in the sand sheets dated to the LGM, whereas only Holocene sequences are preserved in the rock shelters. That different geomorphic environments can produce different occupation records is an important consideration in making comparisons within and between regions as important data about human land use may be overlooked when only select site types are targeted for analysis. The research and preservation bias of Holocene age rock shelters in apparent across northwestern Australia, and has been behind many theoretical discussions of Holocene intensification, and apparent abandonment and/or gaps in the rock shelter record. These theories might be tested by further excavation of locations outside and away from rock shelters, even where there are no surface indications of artefacts. Across northwestern Australia greater consideration needs to be given to site types and to site formation processes which may have influenced the temporal distribution of archaeological sites and deposits. In many cases cultural explanations for regional chronological patterns may only be considered after a

multi-disciplinary approach to other explanations for change.

## Acknowledgements

Facilities and supervision for OSL sample processing were willingly and expertly provided by Dr. Jon Olley (C.S.I.R.O., Canberra) and Dr. Bert Roberts (University of Wollongong). I gratefully acknowledge the assistance of Assoc. Prof. Lesley Head, Dr. Richard Fullagar, Dr. Jenny Atchison and others in the field, and sincerely thank the Marralam Aboriginal Community for permitting access to their land and use of their outstation facilities. I also thank Dr. Richard Fullagar and the anonymous reviewer for their comments on the manuscript.

## References

- Allen, J. 1994 Radiocarbon determinations, luminescence dating and Australian archaeology. *Antiquity* 68:339-343.
- Allen, H. and Barton, G. 1989 *Ngarradj Warde Djokkeng: White Cockatoo Dreaming and the prehistory of Kakadu*. Sydney: Oceania Publications. *Oceania Monograph* 37.
- Atchison, J. 2000 Continuity and Change: A Late Holocene and Post-Contact History of Aboriginal Environmental Interaction and Vegetation Process from the Keep River Region, Northern Territory. Unpublished PhD thesis, University of Wollongong, Wollongong.
- Atchison, J., Head, L. and Fullagar, R. in prep. Archaeobotany of fruit seed processing in a monsoon savanna environment: evidence from the Keep River region, Northern Territory, Australia.
- Attenbrow, V., David, B. and Flood, J. 1995 Menngge-ya and the origin of points: New insights into the appearance of points in the semi-arid zone of the Northern Territory. *Archaeology in Oceania* 30:105-120.
- Balme, J. 2000 Excavations revealing 40,000 years of occupation at Mimbi Caves, south central Kimberley, Western Australia. *Australian Archaeology* 51:1-5.
- Boer-Mah, T. S. 2002 Beyond the Dripline: Comparison of Rock Shelters and Excavated Open Sites in the Keep River region, Northern Territory, Australia. Unpublished Honours thesis, University of Sydney, Sydney.
- David, B., McNiven, I. J., Flood, J. and Frost, R. 1990 Yiwarralarlay 1: Archaeological excavations at the Lightning Brothers Site, Delamere Station, Northern Territory. *Archaeology in Oceania* 25:79-84.
- Dent, R. J. Jr. 1995 *Chesapeake Prehistory: Old Traditions, New Directions*. New York: Plenum Press.
- Dorth, C. E. and Roberts, R. G. 1996 An evaluation of radiocarbon chronologies at Miriwun rock shelter and the Monsmont site, Ord Valley, east Kimberley, Western Australia. *Australian Archaeology* 42:24-34.
- Farrand, W. R. 2001 Sediments and stratigraphy in rockshelters and caves: A personal perspective on principles and pragmatics. *Geoarchaeology* 16(5):537-557.
- Fifield, L. K., Bird, M. I., Turney, C. S. M., Hausladen, P. A., Santos, G. M. and di Tada, M. L. 2001 Radiocarbon dating of the human occupation of Australia prior to 40 ka – success and pitfalls. *Radiocarbon* 43(2B):1139-1145.
- Flood, J. 1970 A point assemblage from northern Australia. *Archaeology and Physical Anthropology in Oceania* 5:25-27.
- Frankel, D. 1990 Time inflation. *New Scientist* 127(1724):52-53.
- Fullagar, R. and Head, L. 1999 Aboriginal landscapes of the northwest Northern Territory, Australia. In: Layton, R., Ucko, P. and Austin, D. (eds). *Frontiers of Landscape Archaeology*, pp 322-335. London: Routledge.
- Fullagar, R. L. K., Price, D. M. and Head, L. M. 1996 Early human occupation of northern Australia: Archaeology and thermoluminescence dating of Jinmium rock-shelter, Northern Territory. *Antiquity* 70:751-773.

- Harrison, R. and Frink, D. S. 2000 The OCR carbon dating procedure in Australia: New dates from Wilinyjibari Rockshelter, southeast Kimberley, Western Australia. *Australian Archaeology* 51:6-15.
- Head, L. 1996 Rethinking the prehistory of hunter-gatherers, fire and vegetation change in northern Australia. *The Holocene* 64:481-487.
- Head, L. and Fullagar, R. 1997 Hunter-gatherer archaeology and pastoral contact: Perspectives from the northwest Northern Territory, Australia. *World Archaeology* 28:418-428.
- Hiscock, P. 1984 A preliminary report on the stone artefacts from Colless Creek Cave. *Queensland Archaeological Research* 1:120-151.
- Holdaway, S. and Porch, N. 1995 Cyclical patterns in the Pleistocene human occupation of southwest Tasmania. *Archaeology in Oceania* 30:74-82.
- Hughes, P. J. and Sullivan, M. E. 1986 'Aboriginal landscape'. In: Russell, J.S. and Isbell, R.F. (eds) *Australian Soils: the Human Impact*, pp. 117-133. St. Lucia: University of Queensland Press.
- Jones, R. and Johnson, I. 1985 Deaf Adder Gorge: Lindner Site, Nauwalabila I. In: Jones, R. (ed). *Archaeological Research in Kakadu National Park*, pp. 165-227. *National Parks and Wildlife Service Special Publication* 13.
- Leigh, D. S. 2001 Buried artefacts in sandy soils: Techniques for evaluating pedoturbation versus sedimentation. In P.Goldberg., V. Holiday and C. Reid Ferring. (eds) *Earth Sciences and Archaeology*. New York: Kluwer Academic/Plenum Publishers.
- Lewis, D. 1988 *The Rock Paintings of Arnhem Land, Australia: Social Ecological and Material Culture Change in the Post-Glacial Period*. Oxford: *British Archaeological Reports International Series* 415.
- Lourandos, H. 1997 *Continent of Hunter-Gatherers: New Perspectives in Australian Prehistory*. Cambridge: Cambridge University Press.
- Lourandos, H. and David, B. 1998 Comparing long-term archaeological and environmental trends: North Queensland, arid and semi-arid Australia. *The Artefact* 21:105-112.
- Marshall, E. 2001 Pre-Clovis sites fight for acceptance. *Science* 291:1730-1732.
- McConnell, K. and O'Connor, S. 1997 40,000 year record of food plants in the southern Kimberley Ranges, Western Australia. *Australian Archaeology* 45:20-31.
- McNiven, I. J., David, B. and Flood, J. 1992 Delamere 3: Further excavation at Yiwularlay (Lightning Brothers Site), Northern Territory. *Australian Aboriginal Studies* 1:67-73.
- Michie, J. L. 1983 Bioturbation, gravity and site formation processes in the coastal plain of South Carolina. In S.W. Green & A. Goodyear (eds) *Abstracts of the 40th Southeastern Archaeological Conference, Columbia, South Carolina*. Fayetteville: Arkansas Archaeological Survey. *Bulletin* 26:23.
- Morwood, M. J. 1981 Archaeology of the central Queensland highlands: The stone component. *Archaeology in Oceania* 16:1-52.
- Morwood, M. J. and Hobbs, D. R. 1995 Themes in the prehistory of tropical Australia. *Antiquity* 69:747-768.
- Morwood, M. J., Hobbs, D. R. and Price, D. M. 1995 Excavations at Sandy Creek 1 and 2. St Lucia: University of Queensland. *Tempus* 3: 71-85.
- Mulvaney, J. and Kamminga, J. 1999 *Prehistory of Australia*. Sydney: Allen and Unwin.
- O'Connor, S. 1995 Carpenter's Gap rockshelter 1: 40,000 years of Aboriginal occupation in the Napier Ranges, Kimberley, WA. *Australian Archaeology* 40: 58-59.
- O'Connor, S. 1996 Thirty-thousand years in the Kimberley: results of excavation of three rockshelters in the coastal West Kimberley, W.A. St Lucia: University of Queensland. *Tempus* 3:26-49.
- O'Connor, S., Veth, P. and Barham, A. 1999 Cultural versus natural explanations for lacunae in Aboriginal occupation deposits in northern Australia. *Quaternary International* 59:61-70.
- Ouzman, S., Tacon, P., Mulvaney, K. and Fullagar, R. 2002 Extraordinary engraved bird track from North Australia: Extinct fauna, Dreaming Being and/or aesthetic masterpiece? *Cambridge Archaeological Journal* 121:103-112.
- Parkington, J. 1989. A view from the south: southern Africa before, during and after the Last Glacial Maximum. In: Gamble, C. and Soffer, O. (eds.). *The World at 18,000 BP. 2: Low Latitudes*, pp. 214-228. London: Unwin Hyman.
- Robbins, L. H., Murphy, M. L., Brook, G. A., Ivester, A. H., Campbell, A. C., Klein, R. G., Milo, R.G., Stewart, K. M., Downey, W. S. and Stevens, N. J. 2000 Archaeology, palaeoenvironment, and chronology of the Tsodilo Hills White Paintings Rock Shelter, Northwest Kalahari, Botswana. *Journal of Archaeological Science* 27:1085-1113.
- Roberts, R. G. 1997 Luminescence dating in archaeology: from origins to optical. *Radiation Measurements* 275/6:819-892.
- Roberts, R. G. and Jones, R. 2001 Chronologies of carbon and silica: Evidence concerning the dating of the earliest human presence in Northern Australia. In Tobias, P.V., Raath, M.A., Moggi-Cecchi, J. and Doyle, G.A. (eds) *Humanity from African Naissance to Coming Millennia*, pp. 239-248. Johannesburg: WITS University Press.
- Roberts, R. G., Jones, R. and Smith, M. A. 1994 Beyond the radiocarbon barrier in Australian prehistory. *Antiquity* 68:611-616.
- Roberts, R., Walsh, G., Murray, A., Olley, J., Jones, R., Morwood, M., Tuniz, C., Lawson, E., Macphail, M., Bowdery, D. and Naumann, I. 1997 Luminescence dating of rock art and past environments using mud-wasp nests in northern Australia. *Nature* 387:696-699.
- Roberts, R., M. Bird, J. Olley, R. Galbraith, E. Lawson, G. Laslett, H. Yoshida, R. Jones, R. Fullagar, G. Jacobsen and Q. Hua. 1998a Optical and radiocarbon dating at Jinnium rock shelter, northern Australia. *Nature* 393:358-362.
- Roberts, R., Yoshida, H., Galbraith, R., Laslett, G., Jones, R. and Smith, M. 1998b Single-aliquot and single-grain optical dating confirm thermoluminescence age estimates at Malakunanja II rock shelter in northern Australia. *Ancient TL* 16(1):19-24.
- Roberts, R. G., Galbraith, R. F., Olley, J., Yoshida, H. and Laslett, G. M. 1999 Optical dating of single and multiple grains of quartz from Jinnium rock shelter, northern Australia: Part II, Results and Implications. *Archaeometry* 41:2:365-395.
- Schrire, C. 1982 *The Alligator Rivers: Prehistory and Ecology in Western Arnhem Land*. Canberra: Australian National University. *Terra Australis* 7.
- Smith, M. A. 1989 The case for a resident human population in the Central Australian Ranges during full glacial aridity. *Archaeology in Oceania* 24:93-105.
- Smith, M. A. and Sharp, N. D. 1993 Pleistocene sites in Australia, New Guinea and Island Melanesia: geographic and temporal structure of the archaeological record. In Smith, M. A., Spriggs, M. and Fankenhauer, B. (eds) *Sahul in Review, the Archaeology of Australia, New Guinea and Island Melanesia*, pp. 37-59. Canberra: Research School of Pacific Studies, Australian National University.
- Tacon, P. and Brockwell, S. 1995 Arnhem Land prehistory in landscape, stone and paint. *Antiquity* 69:676-695.
- Tacon, P., R. Fullagar, S. Ouzman and K. Mulvaney 1997 Cupule engravings from Jinnium-Granilpi northern Australia. and beyond: Exploration of a widespread and enigmatic class of rock markings. *Antiquity* 71:942-65.
- Tacon, P. S. C., Mulvaney, K., Fullagar, R. and Head, L. 1999 'Bradshaws' - An eastern province? *Rock Art Research* 162:127-128.

- Ulm, S. in press Themes in the archaeology of mid-to-late Holocene Australia. In Murray, T. (ed.) *Archaeology from Australia*. Melbourne: Australian Scholarly Publications. 19.
- Van Nest, J. 2002 The good earthworm: How natural processes preserve upland Archaic archaeological sites of Western Illinois, U.S.A. *Geoarchaeology* 171: 53-90.
- Veth, P. 1995 Aridity and settlement in northwest Australia. *Antiquity* 69:733-746.
- Wallis, L. 2001 Environmental history of northwest Australia based on phytolith analysis at Carpenter's Gap 1. *Quaternary International* 83-85:103-117.
- Walsh, G. 2000 *Bradshaw Art of the Kimberley*. Melbourne: Takarakka Nowan Kas Publications.
- Ward, I. 2003 Lost in the Sands of Time. Geoarchaeology of the Keep River Region, Northern Territory, Australia. Unpublished PhD thesis, University of Wollongong, Wollongong.
- Ward, I. and Larcombe, P. 2003 A process-orientated approach to archaeological site formation: Application to semi-arid northern Australia. *Journal of Archaeological Science* 30:1223-1236.
- Ward, I. A. K., Nanson, G. C., Head, L. M., Fullagar, R. L. K., Price, D. M. and Fink, D. 2004 Late Quaternary landscape evolution in the Keep River Region, northwestern Australia. *Quaternary Science Reviews* in press.
- Ward, I., Fullagar, R., Head, L. M., Price, D. M., Head, M. J., Taçon, P. and Boer-Mah, T. 2005 Dating human occupation of rock shelter sites and adjacent landscapes in the Keep River Region, Northern Territory, Australia. *Geoarchaeology* in press.
- Watchman, A., Tacon, P., Fullagar, R. and Head, L. 2000 Minimum ages for pecked rock markings from Jinmium, north western Australia. *Archaeology in Oceania* 35:1-10.
- Waters, M. R. and Kuehn, D. D. 1996 The geoarchaeology of place: The effect of geological processes on the preservation and interpretation of the archaeological record. *American Antiquity* 613:483-497.
- Woodroffe, C. D., Chappell, J., and Thom, B. G. 1988 Shell middens in the context of estuarine development, South Alligator River, Northern Territory. *Archaeology in Oceania* 23:95-103.



## NORTH AMERICAN ARCHAEOLOGY SERIES: BLACKWELL STUDIES IN GLOBAL ARCHAEOLOGY

Edited by  
TIMOTHY R. PAUKETAT AND DIANA DIPAOLO LOREN

Blackwell Publishing  
2004  
ISBN 0-631-23184-6  
RRP US\$69.30  
(paperback)