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Amy Roberts, Michael Morrison, Ian Moffat and Heather Burke
AN ANALYSIS OF SURFACE STONE ARTEFACTS ASSOCIATED WITH ANTHROPOGENIC EARTH MOUNDS FROM CALPERUM STATION, SOUTH AUSTRALIA, TOGETHER WITH A CONSIDERATION OF COMPARATIVE MURRAY DARLING BASIN DATA

Joanne Thredgold¹,², Amy Roberts¹ and the River Murray and Mallee Aboriginal Corporation

¹College of Humanities, Arts and Social Sciences, Flinders University, GPO Box 2100, Adelaide, SA 5001, Australia
²Australian Heritage Services, 188 Gilles St, Adelaide, SA 5000, Australia

Abstract

This paper presents the results of surveys and detailed recordings of surface stone artefacts associated with 13 anthropogenic earth mounds at Calperum Station in South Australia’s Riverland region. The low density assemblages were dominated by small unmodified chert and silcrete flakes produced by knapping strategies aimed at maximising the raw materials. A comparatively large amount of coarse, heat shattered silcrete was also identified, which is likely to have been used as heat retainers in the earth mounds. These findings are similar to many mounds in other parts of the Murray Darling Basin and lend support for Westell and Wood’s (2014) proposition that Riverland mounds were likely functionally specific loci of food and fibre processing activities (via ovens) and were not used as general occupation sites.
Introduction

Anthropogenic earth mounds in Australia are located in both the south-east and northern tropical regions of the country. Major mound provinces include the Murray Darling Basin, northern Adelaide Plains (South Australia), south-western Victorian volcanic plains, Cape Yorke Peninsula (Queensland) and the coastal plains of the northernmost region of the Northern Territory (see Balme and Beck 1996; Brockwell 2006; Klaver 1990; Westell and Wood 2014). In general these features comprise of mounded deposits of rich organic sediments, charcoal/ash and other oven debris, such as heat retainers (burnt clay and stone) (Balme and Beck 1996:39; Bonhomme 1990:31; Coutts et al. 1976:3–4; Westell and Wood 2014:33). However, it must be noted that archaeological studies have revealed variations in mound typology, as well as content/stratigraphy at local and regional scales and, as such, caution must be applied in using the ‘earth mound descriptor’ without qualification (Balme and Beck 1996:39). Indeed, earth mounds may contain varying cultural remains in addition to charcoal/ash and heat retainers, such as stone artefacts, faunal remains, burials and evidence of structures once erected on them (Coutts et al. 1976:3–4; Johnston 2004; Klaver 1998; Littleton– et al. 2013; Martin 2006; Pardoe 2003; Westell and Wood 2014; Williams 1988:84–127). Such differences have resulted in a range of interpretations relating to ‘function, construction and economic role’ (Balme and Beck 1996:39).

In this article we focus our attention on the stone artefacts associated with earth mounds in the Murray Darling Basin (MDB) as a means to further explore regional earth mound variation. In doing so we compare new data collected as a result of the Calperum1 Station Research Project with prior MDB studies (detailed below) (Figure 1). Thus, this project was designed to answer two main questions. First, what can the stone artefacts associated with the earth mounds at Calperum Station allow us to infer about the activities carried out at these

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1 Aboriginal toponyms are emphasised and explained in this paper as a means of contributing to the decolonisation of local histories. Calperum is an Erawirung word, said to mean ‘branch road’ or ‘short cut’, also spelled ‘Kalparum’ (Tindale c.1934-c.1991).
features? Secondly, how do these assemblages compare with other earth mound studies undertaken in the MDB?

The Calperum Station Research Project is a collaborative endeavour between the River Murray and Mallee Aboriginal Corporation (RMMAC) and Flinders University. The earth mounds that are the focus of this study fall within the former First Peoples of the River Murray and Mallee Native Title Claim (see Turner v South Australia 2011 FCA 1312 [18 November 2011]), the rights and interests of which are now managed by RMMAC. Amongst other objectives, the project aims to record a range of sites to assist with their future protection. The protection of the mounds is particularly important, as they are subtle cultural features that, due to their proximity to the river, have been subject to trampling by sheep in the historic period, and continue to be subject to disturbance by rabbits. As RMMAC did not want the mounds or surrounding cultural heritage disturbed at the time this research project took place, the new data in this study originates from surface stone artefact assemblages associated with earth mounds.

**Earth Mounds and Associated Stone Technologies in the Murray Darling Basin**

Whilst much attention has been paid to the characteristics of earth mounds in the MDB, such as dimensions, distribution and overall contents (excluding SA where no MDB mounds have been excavated), comparatively little detailed analysis has taken place in relation to the stone artefacts associated with these features, largely due to the small numbers of artefacts found during these studies (see Buchan 1980; Coutts et al. 1979; Johnston 2004; Lane 1980; Pardoe 2003; Simmons 1980; Westell and Wood 2014). MDB earth mounds have variously been interpreted as deriving from the repeated use of pit ovens for food preparation (particularly in relation to the processing of aquatic plants such as *Typha* spp.), camping for short and/or extended periods, particularly during flooding events, and burial places (Coutts et al. 1979; Johnston 2004; Klaver 1998; Martin 2006; Pardoe 2003; Westell and Wood 2014). Uncalibrated
radiocarbon dates from earth mound excavations indicate that the use of earth mounds largely occurred during the mid to Late Holocene (see Jones [2016:92] for a summary). The location of the mound studies referred to in this section are shown in Figure 1.

![Figure 1](image_url)  

**Figure 1** Case study area and earth mound regions in the MDB (adapted from Jones [2016:11] and Westell and Wood [2014:32]). Map by Alexander Moss.

Following a survey of 122 earth mounds in the Nyah Forrest, Victoria, Coutts et al. (1979) selected three of these mounds for more detailed study and excavation. The surface soil had already been removed from the larger of the three mounds and the two smaller mounds were covered with alluvial deposits due to periodic inundation (Coutts et al. 1979:33, 36), as such there was no evidence of surface stone artefacts. Seven stone artefacts were recovered from the larger mound, but only ‘a few’ flakes were found in one of the smaller mounds (Coutts et al. 1979:61, 64). Three utilised shells (*Velesunio* spp.) were identified in the largest mound, as well as a range of faunal remains and three human burials (Coutts et al. 1979:61). Overall, Coutts et al. (1979: 84–87) found that the larger mound was complex and
had been deliberately constructed as a campsite for use during flood periods, whereas the two smaller mounds were more uniform in their sediments and unlikely to have been used for camping.

Simmons (1980:57–86) surveyed the surface of 75 mound sites within two areas of the central Murray floodplain, from Lake Jilleroo to Tooley Landing on the Murray River; and a system of lakes and channels between Nyah on the Murray River and the Wakool River in New South Wales (NSW). The surface and augered samples of the mounds contained occupation debris that included burnt clay nodules, charcoal, burnt bone, crayfish (*Cherax destructor*) and predominantly *V. ambiguus* shells, confirming the sites as the products of cultural activities (Simmons 1980:63–64). Stone artefacts were rare at these mounds—with only single flakes found on top of two atypical mounds located high above the floodplain on red Mallee soil (Simmons 1980:73–76). Simmons (1980:73, 84) suggested that, despite possessing occupational layers and debris similar to the other mounds, these two sites may have been seasonal base camps rather than mounds.

Buchan (1980:43) surveyed around Lake Coomaroop (near Tooleybuc) and along both sides of the creek connecting it to the Murray River, continuing along the northern bank of the Murray to Nyah. At Lake Coomaroop, seven mounds were grouped together at the southern end, and a surface scatter of stone artefacts extended for 120 m along the northeastern sand terrace (Buchan 1980:44–45). Five mounds were identified along the margins of the creek, and nine mounds on the northern bank of the Murray River (Buchan 1980:45–46). Stone artefacts were absent on the surface of the mounds (Buchan 1980:44–46) and not encountered during subsequent test pitting and hand augering of four mounds by Sullivan and Buchan (1980:89, 92).

Lane (1980) surveyed 81 earth mounds at the junction of the Loddon and Little Murray River near Swan Hill. Several isolated stone artefacts were identified during the survey but not on the mounds (Lane 1980:113). The majority of these mounds were in a poor state of preservation due to agricultural
practices. Lane (1980:115) determined that around half were located on terrain that would have been above water during modest flood periods, with the other half located in lower lying marshy areas. Lane (1980:116) suggested that the mounds were carefully located to allow access to resources from the streams and marshes.

In an extensive pedestrian survey of the cultural heritage of Barmah National Park, Victoria, stone artefacts were found in very small numbers and usually only in association with earth mounds (Bonhomme 1990:73). In total, 86 mounds were identified, five of which had between 1–5 stone artefacts associated with them (1990:51, 74). Due to the proximity to the Murray River and the floodplain location, the area is regularly inundated and Bonhomme (1990:78) noted that any sites near mounds may have been covered by alluvium. Bonhomme (1990:51, 78) suggested that the mounds had different uses: the smaller mounds may have been single activity sites, but the larger mounds showed evidence of a variety of activities, including knapping and food processing.

Balme and Beck (1996:39–49) recorded the size, distribution and composition of 63 mounds within the Macquarie Marshes region, NSW. No excavations were carried out, but one mound was augered to provide information about the composition of the mounds (Balme and Beck 1996:41). A few stone artefacts were observed on the surface of five mounds, but none were reported in the auger sample (Balme and Beck 1996:40-41). The authors noted that stone suitable for manufacturing artefacts was not widely available in the immediate area (Balme and Beck 1996:40–41). Balme and Beck (1996) argued that the mounds were not occupied, and instead hypothesised that they could have functioned as gardens, arguing that the ethnohistorical accounts of oven use and camping were largely derived from secondary sources.

Berryman and Frankel (1984) recorded 95 mounds along the Wakool River near Barham, NSW, three of which were excavated. Stone artefacts were not discussed in the context of the surface surveys, and were not found in the excavations (Berryman and Frankel 1984; Frankel 1991:80). Frankel (1991:80) suggested that the smaller mounds, located along small secondary channels, were used as ovens and only during the height of the floods, but the larger mounds, mostly located
along the main river channels, may have also been used as campsites before and after floods.

Klaver (1998:122–135) recorded 311 mounds and excavated four on the central Murrumbidgee riverine plain, NSW. Artefacts were not found on ‘[t]he majority of mounds’, and the raw material trends matched the broader local patterns (Klaver 1998:217). Mound surfaces also had low artefact densities, mostly flakes with use-wear or retouch or broken fragments of larger artefacts, such as grindstones and hammerstones (Klaver 1998:218). Stone artefact assemblages from two excavated mounds were also small, both in number (n=42 and 31) and size, with all artefacts (including cores) less than 20 mm in length (Klaver 1998:219–220). Mound formation was interpreted to be the result of the repeated use of earth ovens, and mounds were only incidentally used as campsites or for other functions (Klaver 1998:281). Klaver (1998) did not see the mounds as part of a sedentary settlement system, rather, radiocarbon dates from the mound excavations indicated that their development had been intermittent.

Pardoe (2003:44–45) recorded 270 ashy deposits within the woodland areas of the Menindee Lakes region. Visible on the surface of these deposits were baked termite mound pieces and clay, calcrete and river sandstone heat retainers, faunal remains, and varying amounts of flaked and ground stone artefacts. Pardoe (2003:45) compared these deposits to the mounds described by Martin (2006), noting that, as they contained similar faunal remains and sediments, they were likely to have derived from the repeated use of earth ovens, despite not having the height and regular shape of the Hay Plain mounds. The ashy deposits were largely located near creek and lake inlets and outlets, floodplains, deep river bends, billabongs and swamps that were interpreted as focal points of occupation, providing food and fibre for large numbers of people over extended periods of time, possibly during the late Holocene (Pardoe 2003:45).
At Lake Boort, in the Victorian Mallee region, excavations of one mound demonstrated that the deposit represented an aggregate of intermittent camping activities focused on resource gathering, food production and knapping, dating back at least 2000 years, and most likely formed/used during periods of flooding and abundant food resources (Johnston 2004:55–56). Stone artefacts were evident on the surface and continued throughout the excavated deposit (Johnston 2004:50). Small, locally-available quartz pebbles were knapped on the mound using bipolar strategies, producing large amounts of broken flakes and debitage (Johnston 2004:55). Johnston (2004:55) suggested that the majority of complete flakes had been removed for use elsewhere. Johnston’s (2004) excavations did not reveal evidence for any structural foundations or use of the mound as a primary campsite.

Following an investigation of large earth mounds on the Hay Plain, Martin (2006:12–13, 306–308) concluded that, although mounds were used for different functions, including as habitation platforms and for burials, because they were spatially associated with dense and predictable carbohydrate crops, particularly *Typha* spp. that grew on the floodplains, the primary process that created the mounds was vegetable cooking in heat retainer ovens. The artefact assemblages associated with these mounds were dominated by bipolar microblade technology reflective of local trends associated with the exploitation of locally available quartz pebbles (Martin 2006:217–225). Stone artefacts were visible on the surface and subsequently found throughout the subsurface excavations of two mounds (Martin 2006:127, 144). The artefacts indicated periods of occupation and activities including knapping as well as the use of formal tools that were not manufactured on site (Martin 2006:132).
Westell and Wood’s (2014) study compared earlier studies of a number of Adelaide Plains mounds with 147 mounds in the SA Riverland region, from Wellington to the NSW border, the majority of which were at Katarapko and Chowilla. The authors (Westell and Wood 2014:51–57) found a number of differences, including the shape, spatial organisation, use or non-use of the mounds for burials, and densities of stone artefacts and faunal remains. In both cases, the initial development of the mounds was related to food (and possibly fibre) processing, but it appears that at least some of the Adelaide Plains mounds were also used for burials and as bases of occupation from which the floodplains could be exploited during flood periods. By contrast, high ground was easily accessible in the Riverland region, and thus they argued that the mounds served food processing functions (Westell and Wood 2014:56-57). Surveys of earth mounds at Katarapko and Chowilla found that stone artefacts were a minor component of the mound structure, and were identified on the surface of 57.3% of mounds (Westell and Wood 2014:50, 53). Westell and Wood (2014:53) found that artefacts associated with the mounds were almost exclusively unretouched flakes. This paper specifically expands on and tests these observations, and compares the Riverland assemblages with those of other MDB mounds.

Ethno-historical Records Regarding Earth Mounds and Stone Tools

Early historical accounts and research on the Aboriginal people living along the Murray River suggest that prior to the arrival of Europeans in 1788, the Murray River was one of the most resource-rich parts of Australia, densely populated by many different groups and supporting much larger populations of Aboriginal people than the surrounding semi-arid plains.

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2 Katarapko meaning ‘home for rock crystal’ (Tindale c.1934-c.1991), and Chowilla meaning ‘place of spirits or ghosts’ (Tindale c.1934-c.1991) (also rendered as Tjauwala/Tjowila/Tuawila [Manning 1990:71] and Wila [Woolmer 1986:40-41]).
Historical records of subsistence activities along the Murray River indicate that both game and vegetables were prepared in earth ovens (Angas 1847:54; Berndt and Berndt 1993:77; Eyre 1845 Vol.II:291). *Typha* spp. was both a permanently available food staple and the fibre source for much of the equipment used to procure food (Angas 1847:55, 89–90; Berndt and Berndt 1993:101; Beveridge 1883:42–43; Eyre 1845 Vol.II:269; Gott 1999:41; Krefft 1865:361), including many different kinds of nets for catching ducks and fish, mats of all sizes, tassels, baskets, basket fish traps and necklaces (Eyre 1845:311–312a; Taplin 1879:18, 29, 52, 64a). The fibre for many of these products is likely to have been prepared in earth ovens (Beveridge 1883:42–44; Martin 2006).

Archaeological studies (e.g., Bonhomme 1990; Klaver 1998:196; Ross 1981) have suggested that freshwater mussel shell could replace stone for cutting purposes in some contexts, and this could account for the relative lack of stone artefacts in the context of earth mounds and their association with food and fibre processing in the MDB, where suitable stone is often in short supply. Ethnographic accounts from Angas (1847:55, 66–67, 92, 96) described the use of shell for knives in the broader region, and Beveridge (1883:43–44) also described women gathering and preparing bulrush roots using shell or stone to cut the rhizomes or reeds. Mussel shell (*Alathyria jacksoni* and/or *V. ambiguus*) was identified on 40% of all the mounds surveyed as part of the Calperum Station Research Project (Jones 2016:98), which is in line with Westell and Wood’s (2014:46) finding that shell was present on 44% of the surveyed mounds at Chowilla.

**Geology and Environmental Regime in the Study Area**

The MDB covers a large portion of the southeastern region of Australia, and is the country’s largest and most important water system. Calperum Station is located in SA, near the border with Victoria and NSW. The station boundary is the northern bank of the Murray River at the southcentral corner, with the majority of the station located in the semi-arid Mallee region (Figure 1).
The geomorphology of the Murray channel is complex and includes very small units of a range of landforms, all of which are in close proximity and undergoing different geomorphological processes (Evans 2013:9). Marine inundation from the late Eocene until the middle Miocene, the prior mega-lake Bungunnia, and sediment from tributary rivers have all contributed to the deposits of sand and clay in the basin that are now the dominant features of the Mallee landscape (Evans 2013:5–11). These unconsolidated and semi-consolidated sediments result in very little stone suitable for knapping other than a layer of silcrete and chert principally found in association with the Karoonda Surface, a siliceous unit formed during marine and lake inundations (Brown and Stephenson 1991:315; Gill 1973:33). Figure 2 shows a number of Aboriginal quarries within 30 km of the study area.

A regional study of stone sources has not been conducted for the Riverland to date, but it is likely that the stone quarries shown in Figure 2 are all associated with the Karoonda Surface. As this layer lies close to the modern ground surface and is frequently exposed in the Calperum/Chowilla area (Brown and Stephenson 1991:164), siliceous outcrops within this unit would have been exploited by Aboriginal people. Patches of chert and silcrete from this layer would also have been quarried from the Murray River cliffs; the Marndelbuik and Berribee quarries provide two prominent examples (Grist 1995; Tindale c1934–c.1991; Tindale 1974:211). Gill (1973:33) stated that this layer is at its maximum one metre thick, however Grist (1995:44) identified a silcrete band up to 75 cm thick directly above a chert band up to 60 cm thick at the Berribee quarries. It is likely that other suitable stone sources exist, however identifying the sources of the artefacts used at the Calperum Station mounds is complicated due to the continuous exposure of the Karoonda Surface in the Murray River cliffs.

3 Alternatively ‘Mernsdellbuick’, an Erawirung word said to mean ‘flint hole’ (Tindale c.1934–c.1991), also known as Spring Cart Gully.
**Figure 2** Known stone and ochre quarries near Calperum Station, South Australia. References for the quarries shown here, as well as for other quarries with no spatial information, are included in a second reference list at the end of this paper. The number on the map refers to the reference number. Map by Jarrad Kowlessar.
A detailed geomorphic study was conducted for the Murray River just across the tristate border from Calperum Station by Prendergast et al. (2009). As no similar study has taken place on Calperum Station, Prendergast et al.’s (2009) classifications were tentatively employed as a preliminary framework to provide context for this research.

### Taphonomic Processes in the Study Area

The taphonomic processes active on the floodplains of Calperum Station were considered as part of this project to determine the extent to which human, animal and water flows may have had an impact on stone artefact location and visibility. The study areas are located on a floodplain and are regularly inundated with floodwaters. The thin Quaternary units mantling most of the surface of the MDB contain high proportions of clay, indicating long term low velocity flows (Brown and Stephenson 1991; Gill 1973:4; Prendergast et al. 2009:59; Schumm 1968:39). Sediments, particularly in the western parts of the MDB, are generally very fine as a result of the low dynamics and grades of the Murray River, especially in its later phases (Brown and Stephenson 1991:86; Gill 1973:9). The sediment load in the Riverland section of the Murray is suspended silt and clay (Brown and Stephenson 1991:30; Schumm 1968:39), indicating that modern flows continue to be low energy, a context that is unlikely to disturb the spatial arrangement of artefacts (Petraglia and Potts 1994:229).

The movement of suspended sediments carried by the Murray River has been modelled by de Rose et al. (2004:248). The results of their research indicated that the deposition of sediments in floodplain areas is higher in recent times than it was under the natural regime, suggesting that floodplain sediment accumulation and subsequent artefact burial may have occurred at higher rates since European occupation (de Rose et al. 2004:248). Currently, between 0–1 kilotons of sediment are deposited in the study area per year (Moran et al. 2005:9). However, those same fine sediments are also highly susceptible to erosion during dry seasons (McTainsh et al. 2011:32). The
loss of sediments from the study area due to aeolian erosion is difficult to assess due to the number of local variables and the lack of local data (McTainsh et al. 2011:12–13; Newall et al. 2009:166–167), but as the MDB is still one of the most actively eroding regions on the continent, despite the many recent improvements in pastoral management (McTainsh et al. 2011:33), erosion of the study area and the possibility that assemblages are a lag deposit must be considered (although alluvium may still be deposited during flood periods—see Jones [2016:68–79] for additional discussion regarding alluvium on mounds at Calperum Station). The Reny Island Billabong (see later sections for site description) in particular is likely to have been trampled significantly by sheep (and cattle) milling around the waterbody, leading to wind erosion during dry periods. Former pastoral use has heavily reduced the vegetation from pre-European settlement levels, and whilst pest and weed control has been carried out, current soil salinity levels mean that plant regrowth is limited in many places, increasing the risk of erosion (Newall et al. 2009:167).

The evidence of high Aboriginal occupation densities in this area prior to the arrival of Europeans (Clarke 2009:147; Eyre 1845 Vol II; Mitchell 1839; Webb 1984) and the use of the study area predominantly for sheep grazing in the historic period suggests that trampling disturbances by humans and pastoral activities are also likely to be significant factors in the current visibility of surface stone artefacts. A more vertical surface inclination of artefacts can be used to indicate both animal trampling in wet periods and water disturbance (Eren et al. 2010:3019; Schick 1991), since in dry periods on compact substrates artefacts are more likely to disperse horizontally (Gifford-Gonzalez et al. 1985:806–808). Overall, the spatial integrity of deposits in the study area is more likely to depend on the amount of time that they have been exposed on the surface, with integrity decreasing the longer the deposit is exposed to human and animal trampling (Petraglia and Potts 1994:230).

One further taphonomic process that could have had an impact on the stone artefacts is heat damage from either mound use or surface fires. Experiments conducted by Buenger (2003:69-84) on stone artefacts in forest fires indicate that it is unlikely that a surface fire, particularly in a riparian zone, would
have the duration or intensity required to create heat damage such as potlidding, crenated fractures and crazing, except where artefacts were in association with burning roots or immediately beneath a burning fallen tree. Heat-damaged surface stone artefacts may indicate deposition contemporaneous with mound use, whereas it is unclear whether artefacts without heat damage were deposited contemporaneously or subsequent to mound use.

Methods

The fieldwork for this project was conducted during two field trips, the first as part of a Finders University Archaeology Field School in September 2015 and the second as part of a field trip in April 2016. A number of areas were surveyed for stone artefacts during both field seasons, however this paper only presents the results from the surface of the mounds and 10 m beyond their external boundaries.

The surfaces of 13 mounds were carefully surveyed for stone artefacts. The study areas for this project consisted of four mound clusters: two around billabongs and two on the edges of meandering anabranches of the Murray River (see also Jones 2016; Jones et al. 2017); they are located at Reny Island Billabong, Hunchee Island Billabong, in the Hunchee Creek Precinct and at Ral Ral Creek. The mounds were surveyed for artefacts in most cases following their initial identification by Jones (2016; Jones et al. 2017) and time constraints determined the number of mounds that were surveyed in each cluster.

Average mound diameters varied according to environmental zone location, ranging from roughly 10 to 20 m in diameter, with most below 0.5 m in height (see Jones 2016 for full descriptions). Following Prendergast et al.’s (2009) study, these survey areas were tentatively proposed to be located on the Mulcra Island System, which is predominantly vegetated with Black Box (*Eucalyptus largiflorens*), a variety of saltbushes, including *Atriplex* spp., Nitre Bush (*Nitraria billardierei*) and lignum (*Muehlenbeckia florulenta*), with some *E.s camaldulensis*. *E. largiflorens* trees are common along the anabranches but less
common at the billabongs, and there is little vegetation on the floodplain, apart from Round-Leaf Pigface (or Rounded Noon-Flower) (*Disphyma crassifolium*). *Mesembryanthemum* spp. were identified on the surface of many of the mounds, but not in any other locations (Jones 2016:68). Surface visibility varied considerably due to vegetation and leaf litter.

The Reny Island Billabong is a small relict section of a paleochannel close to the current course of the Murray. The margins of the billabong contained five earth mounds, all of which were surveyed. There were also two stone artefact scatters and isolated stone artefacts, a hearth, a small shell midden and a scarred tree in this location (Jones 2016:68). Two mounds had been disturbed by rabbits, and visibility varied due to leaf litter. Sediments around the edge were grey gilgai clay, apart from two fine white sand ‘beaches’ on either side of the billabong. Water levels in the billabong are artificially maintained by a pump at the northern tip. The Reny Island
Billabong held water in the September 2015 field season, but was dry during the April 2016 visit.

The Hunchee Island Billabong mounds were situated on the northern side of the billabong. The mounds were on the eastern edge of a red sandy rise, although sediments around the very edge of the billabong were grey, as per the other locations. The red sandy rise is likely to be a relict and eroded section of what Gill (1973:43–44) refers to as the Rufus Formation, or, following Prendergast et al. (2009:58), as a relict section of the Neds Corner Land System. Four mounds were identified at the Hunchee Island Billabong; two on the northern side were surveyed for artefacts.

The Hunchee Creek Precinct mounds were located on the northwestern side of the eastern end of the creek as it curves around Little Hunchee Island. The sediment was grey gilgai clay and light sand. Water levels in this creek are artificially maintained by a system of sluices. Four out of 13 mounds identified at this location were surveyed.

The Ral Ral Creek mounds were situated just south of the Hunchee and Ral Ral Creek intersection on Hunchee Island (on the eastern side of Ral Ral Creek). They are also located on the grey gilgai clay. The Ral Ral Creek area included both clear and thickly vegetated areas, and large amounts of tree litter, leading to variable visibility during survey. Two out of three mounds were surveyed.

All artefacts were recorded in situ. The stone artefact characteristics recorded included: raw material and technological type; flake axial dimensions (length/width/thickness) and terminations; platform dimensions (width/thickness) and characteristics (cortial/single surface/multiple surface/faceted/shattered); number and direction of dorsal scars; evidence of platform preparation and bipolar knapping; number of platforms and complete negative scar measurements on cores; the location of retouch on retouched flakes (following Holdaway and Stern 2004:157-158); and evidence of heat damage and the degree of cortex coverage (0/<50/>50/100%) for all artefacts (for the full list of artefact variables see Thredgold 2017). Artefact characteristics were
recorded in the field on a Microsoft Excel spreadsheet loaded onto an LG Nexus X5 tablet.

The recording scheme in this analysis is based on a technological approach, which allows for artefacts to be recorded based on their observable attributes (Andrefsky 2005; Clarkson and O'Connor 2006; Hiscock 2007:202–203). This approach was selected primarily because earth mound research in the Riverland and other parts of the MDB indicated that stone artefacts found on the surface of mounds were frequently unretouched flakes, and retouched or formal types of artefacts are uncommon in surface assemblages generally in the MDB (Balme and Beck 1996:40; Bonhomme 1990:73; Coutts et al. 1979:57; Gill 1973:89; Klaver 1998:217; Westell and Wood 2014:53).

The surface inclination of all artefacts was recorded in terms of three possible orientations: ‘flat’, indicating it was parallel to the ground; ‘angled’, to indicate that it was on an angle that exceeded 30 degrees to the ground surface and was partially buried on one edge; or ‘vertical’ to indicate that the artefact was aligned on, or close to, an angle of 90 degrees to the ground surface and partially buried on one edge (after Eren et al. 2010). Although it was not possible to determine whether artefacts had been displaced horizontally or vertically (see Eren et al. 2010; Gifford-Gonzalez et al. 1985), artefacts within 10 m of the external boundaries of the mounds were included in this study to allow for horizontal displacement.

Results

In total, 13 mounds were surveyed, with 33 stone artefacts identified. Five artefacts were found directly on top of two mounds, and a further nine mounds had low numbers of stone artefacts within 10 m of their outer boundaries. Two mounds had no stone artefacts on or within 10 m of the edges of the mounds. All artefacts were found to be lying flat on the ground surface, indicating they had not been partially trampled into the ground or disturbed by high velocity flows.
Artefact Distribution, Raw Materials and Unretouched Flakes
The distribution of artefacts at individual mounds is outlined in Table 1. These mounds were recorded in detail by Jones (2016 and Jones et al. 2017). The table differentiates between flaked stone artefacts that did not show evidence of being affected by heat (A) and those that did (HAA). The table also provides information about heat shattered stone (HSS) found on the mounds or within 10m of their edges.

Table 1 Distribution of artefacts and heat shattered stone on or within 10 m of the external boundaries of earth mounds. A=Artefacts, HAA=Heat Affected Artefacts and HSS=Heat Shattered Stone. RIBB=Reny Island Billabong, HCN=Hunchee Creek Precinct, HIBB=Hunchee Island Billabong and RRCE=Ral Ra Creek. See Jones (2017) for further detail regarding these mounds.

<table>
<thead>
<tr>
<th>Mound ID</th>
<th>Description</th>
<th>On Mound Surface</th>
<th>Within 5m Buffer</th>
<th>Within 10m Buffer</th>
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<td></td>
<td>A</td>
<td>HAA</td>
<td>HSS</td>
<td>A</td>
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<tr>
<td>RIBB2</td>
<td>Above ground hearth/oven</td>
<td>0</td>
<td>0</td>
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<tr>
<td>RIBB3</td>
<td>Oven mound</td>
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<td>0</td>
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<tr>
<td>RIBB4</td>
<td>Oven mound</td>
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<td>0</td>
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<td>0</td>
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<tr>
<td>RIBB5</td>
<td>Oven mound</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<tr>
<td>RIBB6</td>
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<td>0</td>
<td>0</td>
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<td>HCN23</td>
<td>Oven mound</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>HCN22</td>
<td>Oven mound</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>HCN21</td>
<td>Oven mound</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>HCN20</td>
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<td>0</td>
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<td>0</td>
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<tr>
<td>HIBB15</td>
<td>Oven mound</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HIBB16</td>
<td>Oven mound</td>
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<td>0</td>
<td>1</td>
<td>0</td>
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<tr>
<td>RRCE12</td>
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<td>0</td>
<td>0</td>
<td>3</td>
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<td>Oven mound</td>
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<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Totals</td>
<td></td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>

Raw materials identified were silcrete and chert, consistent with the raw materials available in this part of the MDB. The weights are described in Table 2. The overall average length of the flaked artefacts, both complete and broken, was ~20 mm. A surprising finding during this study was substantial amounts of coarse, heat fractured silcrete and resilicified sandstone (classified for the purposes of this study as silcrete), probably obtained from the nearby Murray River cliffs. This material is discussed...
separately in more detail at the end of this section. No evidence of knapping, such as small flakes or numbers of flakes of the same raw material, was found at any of the mounds.

Table 2 All artefact numbers and weights.

<table>
<thead>
<tr>
<th>All Artefacts</th>
<th>Silcrete</th>
<th>Chert</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number</td>
<td>19</td>
<td>14</td>
<td>33</td>
</tr>
<tr>
<td>Total weight (g)</td>
<td>319.3</td>
<td>48.6</td>
<td>367.9</td>
</tr>
<tr>
<td>Heat shatter stone (N)</td>
<td>13</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Heat shatter stone weight (g)</td>
<td>229.5</td>
<td>0</td>
<td>229.5</td>
</tr>
</tbody>
</table>

Table 3 Artefact (excluding heat shattered stone) numbers and weights.

<table>
<thead>
<tr>
<th>Artefacts (ex Heat Shattered Stone)</th>
<th>Silcrete</th>
<th>Chert</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artefact Total (ex HS)</td>
<td>6</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>Artefact (ex HS) total weight (g)</td>
<td>89.8</td>
<td>48.6</td>
<td>138.4</td>
</tr>
<tr>
<td>Core (n)</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Core (g)</td>
<td>25.2</td>
<td>4.1</td>
<td>29.3</td>
</tr>
<tr>
<td>Flaked artefacts (n)</td>
<td>5</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>Flaked artefacts (g)</td>
<td>64.6</td>
<td>44.5</td>
<td>109.1</td>
</tr>
<tr>
<td>Retouched flakes (g)</td>
<td>0</td>
<td>13.5</td>
<td>13.5</td>
</tr>
</tbody>
</table>

The silcrete artefacts were comprised of one core, three unretouched flakes and two pieces of non-diagnostic shatter. The multidirectional core weighed 25.2 g and was 28.49 mm in length, with two complete negative scars ~20 mm in length. Although there was no evidence of bipolar flaking, it is likely that a core this small would need to be stabilised in order to remove flakes. The three unretouched flakes varied considerably. Two were located within five metres of the mound edge; one of these was ~48 mm long and the other a small (~5 mm) distal fragment. The third flake was cone split, ~15 mm long and located within 10 m of the edge of the mound. Of the two platforms remaining, one was formed from a single surface and the other was a multiple surface. None showed evidence of platform preparation, heat or edge damage. Although one of these artefacts was found on the mound, as none of them showed heat damage, they may have been deposited after the mounds had fallen out of use.
There were over twice the number of chert artefacts, but they weighed in total less than half that of the silcrete artefacts, indicating that chert flakes were much smaller overall than silcrete flakes. Chert artefacts were comprised of one bipolar multiplatform core weighing just five grams, two retouched flakes, two complete flakes and seven broken unretouched flakes between 7–42 mm in length, as well as two pieces of non-diagnostic shatter. The chert core weighed 4.1 g and was ~10 mm in length, with two negative scars of similar lengths. The two retouched flakes had extensive retouch along all margins except the platform. Six platforms were intact: two were formed on multiple surfaces and found on single surfaces, and one platform showed evidence of overhang removal. Three flakes showed evidence of core rotation on the dorsal surface and five flakes had edge damage. Only two chert flakes were complete, their lengths were ~7 and 8 mm. All of the retouched and broken flakes were larger than the complete flakes, ranging from 10–42 mm, but the average length was 16.9 mm. The two shattered artefacts and two of the broken unretouched flakes were heat affected—three of these artefacts were found within 10 m of the mound, and one within 5 m.

**Heat Shattered Stone**

Pieces of coarse, heat shattered silcrete and resilificied sandstone were found both on and away from the mounds. They exhibited signs of burning and crenated rather than conchooidal fractures, and were unlikely to be knapping debris or discarded artefacts. Although a relationship between this material and the mounds has not been clearly established, it is likely that it was brought into the study areas from the cliffs of the Murray River and used for heat retaining purposes in combination with clay balls in the mounds. This was an unexpected finding because only baked clay peds had been identified as heat retainer material in the Chowilla and Katarapko areas (Westell and Wood 2014:46, 49), although Pardoe (2003:45) found river sandstone heat retainers on the surface of the Menindee Lakes ashy deposits. It is likely that these stones were used for the same purpose.
Discussion and Conclusions

This is the first detailed study of surface stone artefacts associated with earth mounds and mound complexes in the Riverland district of the Murray River, and it provides a basis for comparison with earth mounds in other MDB regions. The overall small size of the assemblage does not provide an opportunity to examine specific activities being undertaken in the late Holocene in the vicinity of mounds in this region, however it does provide the basis for some general conclusions. Flaked artefacts on or near the mound surfaces were produced without the use of complex knapping strategies, indicated by the single and multiple platform surfaces and a lack of platform preparation. The small sizes of the flaked artefacts are likely to reflect both small parent raw material sizes and, particularly with regard to the small, multidirectional cores and the low weight of the chert flakes, conservation of raw materials.

It is likely that coarse silicified stone was transported to the mounds and used as heat retainers together with clay in the mounds. This stone is easily obtainable from the nearby Murray River cliffs, something not commonly available in the floodplain areas of the MDB. The use of stone in hearths was common in the lower reaches of the Murray, particularly in the gorge section of the river and the Lower Lakes region (Westell and Wood 2014:49; Wiltshire 2006:69, 73) and in the Menindee Lakes ashy deposits (Pardoe 2003:45). The use of stone heat retainers is also consistent with smaller mounds, or an absence of mounds, resulting from earth oven cooking processes (Berndt and Berndt 1993:103–105; Eyre 1845 Vol II:289-290; Pardoe 2003:45; Westell and Wood 2014:49; Wiltshire 2006:69, 73).
although Klaver (1998 Appendix II:27) also noted heat retainers in association with mounds in three cases in NSW.

The average flake length of all flaked artefacts was close to 20 mm. This finding accords with many studies from the MDB (Johnston 2006:55–56; Klaver 1998:219–220; Martin 2006:216), but as this result includes broken flakes, it suggests that complete flake sizes are larger than what is usually found in association with mounds in the MDB. This is likely to be attributable to the availability of good quality stone raw materials demonstrated in Figure 2. Stone suitable for flaking is generally difficult to obtain in the MDB (Bonhomme 1990; Balme and Beck 1996; Coutts et al. 1979; Martin 2006) and, where it is available, it is often flaked using bipolar methods to maximise the small parent material, resulting in many small flakes (Bonhomme 1990; Coutts et al. 1979, Johnston 2004; Klaver 1998; Martin 2006). The lack of knapping floors or large amounts of knapping debitage suggests that knapping was not carried out at the surveyed mounds.

The very low numbers, or absence, of stone artefacts on the Calperum Station mounds suggests that camping did not regularly take place on the mounds themselves. The earth mound studies by Johnston (2004), Klaver (1998) and Martin (2006) have previously indicated that where artefacts are found on the surface of mounds, they continue to be found throughout the mound in excavations. Conversely, where artefacts are not found on mound surfaces, they are also absent, or found only in very small numbers, in subsequent excavations (Balme and Beck 1996; Berryman and Frankel 1984; Buchan 1980; Coutts et al. 1979; Frankel 1991; Klaver 1998; Simmons 1980). This finding is reinforced by the low numbers of heat damaged-vs-undamaged artefacts on or near the mounds, and the high likelihood of net deflation of the ground surface in this part of the MDB in the historic period.

This study located stone artefacts on mounds at a higher rate than Westell and Wood’s (2014:52) finding of 57.3%, but this is most likely due to the sample size, differing survey strategies and the inclusion of artefacts within 10 m of the mound edge for measurement. Westell and Wood’s (2014:52)
finding of overall low numbers of artefacts on mounds, with the majority being unretouched flakes, is supported by this research. The association between surface artefacts and subsurface artefacts can only be conclusively determined through excavations of the Riverland mounds, but the trend throughout studies of the MDB mounds is clear, supporting Westell and Wood’s (2014:56–57) conclusion that the Riverland mounds were used primarily as ovens.

Further research is required to determine the full extent of human and animal trampling impacts on surface lithic assemblages. Excavations in a range of soil types on and around the mounds would assist in understanding how trampling might have affected and possibly displaced artefacts in these contexts, and help to refine interpretations of surface assemblages in this part of the Murray River floodplain. However, it is likely that many of the MDB mounds have suffered similar trampling by animals and stock, and the lack of information about these impacts does not lessen comparisons with other MDB mounds.

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**References for Figure 2**


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17. RNE.


