



GLEN THIRSTY:

The History and Archaeology of a Desert Well

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Abstract

The archaeology of Glen Thirsty, a desert well in the Amadeus Basin, Central Australia, illustrates the changing relationship between the ranges and desert lowlands during the last 1500 years. Historical records and Aboriginal accounts of the site document the regional importance of Glen Thirsty as one of the few wells in this part of the desert. Archaeological excavations and rock art research show that despite its proximity to Puritjarra with its long, late Pleistocene record of occupation, Glen Thirsty only became an important focus of occupation after 1500 BP. Several lines of evidence independently suggest the establishment and consolidation of a new cultural and economic landscape in the Glen Thirsty area around this time. Growing population pressure and shifts in patterns of land-use and economy in the Central Australian ranges may have provided the impetus for more intensive use of the Glen Thirsty area, although the timing of this was constrained by climatic factors. As a rain-fed well in the lower part of the Amadeus Basin, Glen Thirsty is sensitive to shifts in palaeoclimate and its history reflects changes in regional rainfall patterns during the late Holocene.

Introduction

The first European exploring party to enter western Central Australia reached a desert well called 'Glen Thirsty' in October 1872, and then turned back. Led by Ernest Giles, the expedition had set out to find a route from the newly-built Overland Telegraph Line in Central Australia, across the desert, to the west coast of the continent (Giles 2000[1875]). Mounted on horses, Giles and his two companions failed in their attempt to push west, and turned south from Mt Udor through spinifex and sand hill country, finding a shady waterhole at Tjungkupu (Giles 'Tarn of Auber') (Figure 1). Further south, and two and a half months into their expedition, they reached a series of quartzite ridges on the northern rim of Lake Amadeus. Here Giles and Carmichael found a small soakage well (latitude: 24°28'34.9" S, longitude 131°01'55.2" E), which Giles named 'Glen Thirsty', 'for whenever we returned to it ourselves and horses were choking for water' (Giles 2000[1875]:74). The water was 'of a thick and muddy and rather nauseous flavour' and only seeped slowly into its base (2000[1875]:65). Although they substantially enlarged the native well – digging a trench about 6m-long and 2m-deep – there was still barely enough water for the party and their horses.

Attempts to travel west were foiled by lack of water. To the south, Giles was drawn by the highpoints of Mt Olga (Katatjuta) visible on the horizon, but found his way blocked by an impassable salt lake, which he named Lake Amadeus. Here his party 'sank up to our knees (when once the crust was broken) in hot salt mud' and his horses 'floundered about in the bottomless bed



Figure 1 Western Central Australia, showing Glen Thirsty and places mentioned in the text.

of this dreadful lake' (2000[1875]:67). Desperate for water, he fell back to Glen Thirsty three times between 12 and 27 October 1872. Finally, 'not having met with another place in the whole of our travels in this part of the country where another drop of water was to be found' (2000[1875]:75), Giles retreated 80km to Tjungkupu. Looking for a route back to the Overland Telegraph Line and the Finke River, he turned east towards the high country of the George Gill Range, where he found numerous spring-fed waterholes and well-grassed valleys in the area that today forms Watarrka-Kings Canyon National Park.

While camped at Glen Thirsty, Giles explored the surrounding ridges, describing the rock art he saw nearby:

We took a stroll up into the rocks and gullies of the ridges, and found a cave ornamented with the choicest specimens of aboriginal art ... One hieroglyph was most striking. It consisted of two Roman numerals, a V and an I placed together, and representing our figure VI. They were both daubed over with spots, and were painted with red ochre (Giles 2000[1875]:65).

Because of its inaccessible location, Glen Thirsty has had few European visitors since 1872. In 1999, Ross relocated the distinctive 'Roman VI' panel of paintings described by Giles and showed that Glen Thirsty had a wide range of archaeological remains in addition to rock paintings, including stone artefact scatters, rock engravings and several rockshelters with occupation deposit. There were also numerous stick-nest rat (*Leporillus* sp.) middens on rocky ledges in the area. We saw the

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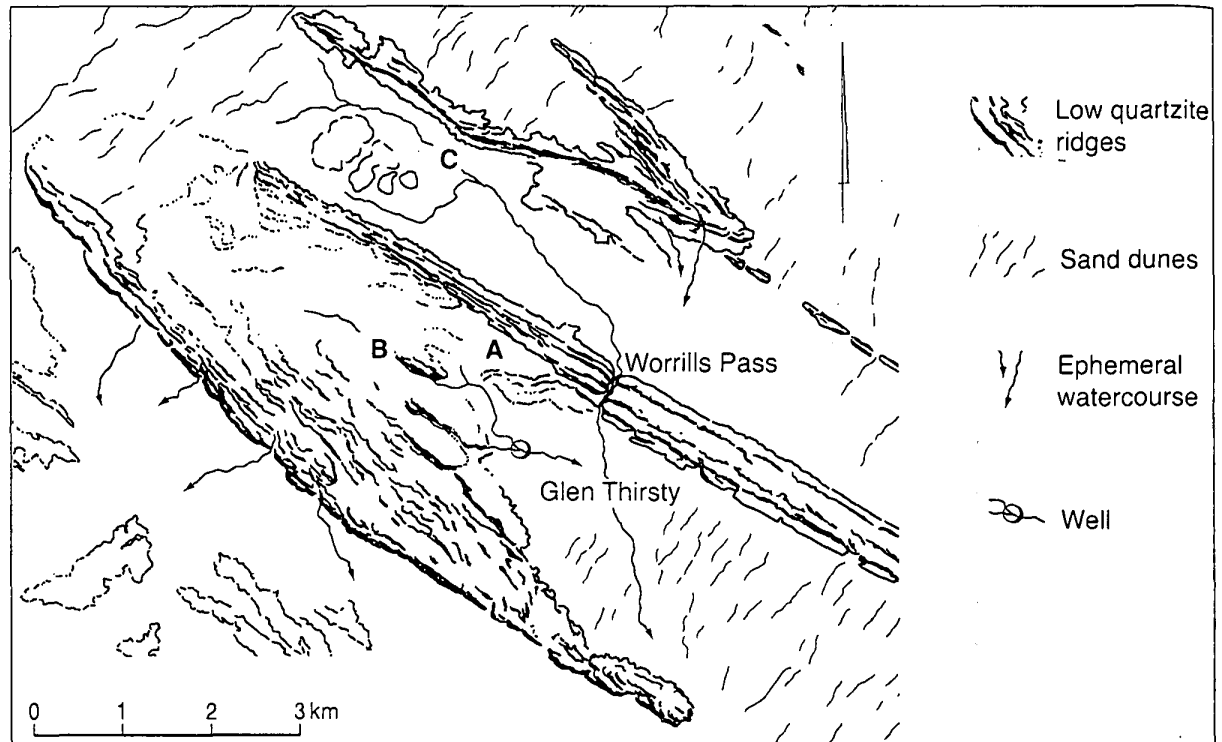


Figure 2 Map of the Glen Thirsty area. Open circle shows probable position of the 1872 well. A: Sites GT1-3, 7-9; B: Sites GT4-6, 10-13 and location of rock holes mentioned by Giles; C: Open sites and quarried outcrop of silcrete.

potential, therefore, to reconstruct the history of an outlying well in the desert lowlands, integrating an analysis of rock art with archaeological excavations at several rockshelter sites and a record of palaeovegetation from the stick-nest rat middens.

One of the key questions concerns the changing relationship between the ranges and desert lowlands during the last 1000–1500 years. This is a period of major change in the Western Desert and Central Australia (Smith 1996; Smith and Ross 2008; Thorley 1999, 2001; Veth 1993, 2005) during which, as Thorley (2001) suggests, the use of marginal or outlying areas (such as Glen Thirsty) may have played an integral adaptive role in sustaining higher regional populations in focal areas of occupation (such as in the George Gill Range, Palmer catchment and Cleland Hills areas). To the north of Glen Thirsty, Tjungkupu (another desert well and waterhole) was only used intensively after 1000 BP, despite its proximity to Puritjarra rockshelter with its longer, late Pleistocene record of occupation. In this context, we set out to establish how events during the late Holocene had affected use of the Glen Thirsty area – and whether or not there was an earlier record of occupation here.

Physical Setting

Today, Glen Thirsty is much as Giles found it in 1872. The area centres on an anticlinal fold of quartzite ridges set in duneveld and low scrub, 20–25km north of Lake Amadeus and approximately 60km southwest of the George Gill Range (Figures 1-2). The complex of ridges forms an isolated rocky catchment, capturing and concentrating run-off and directing this into several creeklines. A narrow pass, called 'Worrill's Pass' by Giles, provides the only convenient passage through a high quartzite ridge that rises out of the surrounding sand plain to

a height of 20m. Just beyond Worrill's Pass, to the south of the ridge, the various creeklines coalesce and flood out into the sand plain creating 'a small and well-grassed plain' with a bright patch of fresh grass and acacia shrubs (Giles' 'glen') (Giles 2000[1875]:60). Further to the south, spinifex and sand dunes again dominate the landscape.

There is no longer any sign of the 1872 well, but the most likely location is 1.6km southwest of Worrill's Pass (Giles (2000[1875]:75) notes the pass was 'a mile from the tank'), where the creek is deeply entrenched and the sand today holds some moisture. Rainwater seepage into shallow sandy aquifers is reflected by the growth of several large eucalypts along the channel in this area. This is also the case, to the north of Worrill's Pass, where the creek forms a gutter running along the base of a quartzite ridge, and several ephemeral waterholes (Figure 2C). Along the upper reaches of the western tributary, some 2.6km west of the pass, there are several rock holes (Figure 2B). Giles (2000[1875]:60) commented on these: 'upon searching further up the gully we found some good-sized rock holes, but unfortunately they were all dry'. The presence of mud rather than sand in the channels, rock holes and waterholes in the upper reaches of these drainage lines suggests only gentle flows of storm water, even after heavy rain. When Giles visited the area it was late in the dry season and some heavy rain had fallen, but not sufficient to recharge local rock holes.

The whole system at Glen Thirsty appears to be an isolated rain-fed catchment focused on the 'glen'. There is no evidence of groundwater discharge or of local springs. In any case, groundwater in the lower part of the Amadeus Basin is mostly saline and undrinkable (Jacobson *et al.* 1989).

Aboriginal History

Aboriginal people knew the Glen Thirsty area as 'Yatajirra', or perhaps 'Nyatajirri' (Smith 2005:17, Footnote 48). When Giles visited the area in October 1872, rain had allowed people to disperse out into the spinifex and sand hill country from their fallback waters, and they were busy firing the surrounding country. Giles (2000[1875]:69) notes 'the whole atmosphere was thick with a smoky haze' and that 'the natives were ever busy at their grass fires'. Aboriginal people also continued to use the soakage between Giles' visits 'as their tracks were visible in the sand around the tank' (Giles 2000[1875]:73) though people avoided direct contact with the exploring party.

By 1880, the pastoral frontier in western Central Australia was represented by a line of outposts from Glen Helen and Hermannsburg Mission in the north, to Tempe Downs and Erldunda in the south. The sand hill country north of Lake Amadeus remained well outside this zone. In 1889 a police patrol, which entered the area a day's walk to the north of Glen Thirsty, encountered a party of 17 Aboriginal people, including old women and children, travelling south towards the salt lake (Willshire 1895; see also Smith 2005:23-25). The onset of severe drought from 1895 to 1906 prompted many Kukatja and Matuntara people to migrate to pastoral stations or Hermannsburg Mission and it seems likely that the area north of Lake Amadeus was only lightly or intermittently occupied after this time. Although the area was increasingly depopulated, an exploring party led by R.T. Maurice, met a small group of Aboriginal people (a man, two women and two children) in July 1902 about 50km northwest of Glen Thirsty (Murray 1904). Some people continued to live in the sand hill country north of Lake Amadeus into the 1920s. Peter Bullah (or Bulla) a Luritja/Matuntara man (the senior custodian of Glen Thirsty into the 1990s) was born around 1920 at Katulkira or Katulykira, a day's walk north of Glen Thirsty, an area that he always described as his 'borning country' (though his father's country was actually Katiti, on the southern side of Lake Amadeus – Maurice 1989:30). His elder brother, Napula Jack, guided Michael Terry's prospecting party through the area in 1932 (Terry 1937; see also Smith 2005:63-65) and Syd Coulthard (grandson of his eldest sister Anyinina) was our guide after Peter Bullah's death in 2001.

By the 1940s, the country on the northern side of Lake Amadeus was becoming more difficult to reach and intergenerational transfer of knowledge was also becoming more difficult to manage. Syd Coulthard recalls visiting the Glen Thirsty area with a string of camels in 1955, shortly after he was initiated at Hermannsburg Mission by Tiger Tjalkalyiri (Peter Bullah's elder brother), and again after the exceptional rains of 1974. In each case, it was an 'emergency trip', prompted by the age and infirmity of senior men and the need to learn the country before they died. In 1955, their travelling route with camels was from Palm Valley to 'Unturu, Wiputa, and Yatajirri', and then through to 'Yirarka and Mutitjulu'. 'My grandfather brought me out here to show all the things, for secret things, to learn more, to get it into my mind' (Syd Coulthard in Smith 2005:72-73). Towards the end of his life, Peter Bullah attempted a similar trip in about 1988, with a carload of young men, but they ran out of fuel in sand hill country. Some then walked out to Watarrka-Kings Canyon; others were rescued by a helicopter organised by Northern Territory Parks and Wildlife Service staff.

The recent Aboriginal history of Glen Thirsty thus emphasises links with the better-watered range country to the north and northeast, to the Ulpanyali-Watarrka-Lilla area. Historical records alone do not allow us to say whether these links reflect the contingencies of the last hundred years, or whether they accurately reflect the pre-contact situation (although the archaeology suggests the latter – see below). But whether or not Glen Thirsty was a discrete clan estate, or part of one that included the better-watered country in the ranges, its use must always have been dependent on seasonal rainfall.

Fieldwork 1999–2004

Initial archaeological appraisal of the sites was limited to a short helicopter and ground reconnaissance by Ross in October 1999 (Ross 2003), organised by Northern Territory Parks and Wildlife Service staff at the request of Peter Bullah. Tapes of Bullah singing songs and relating stories associated with Glen Thirsty were recorded by Ross and now represent a key anthropological document for this area (on file with AIATSIS). In August 2003, Ross and Smith, accompanied by Syd Coulthard, visited Glen Thirsty (again by helicopter) to make a more detailed assessment of the potential of Glen Thirsty for future archaeological research. Syd Coulthard's account of Glen Thirsty has also been lodged on audio CD with AIATSIS.

In August 2004, with better ground access to the area (courtesy of Northern Territory Parks and Wildlife), we were able to make a more extended search of Glen Thirsty. This showed that archaeological remains were concentrated in three main areas (Figure 2), all in the upper reaches of local drainage lines:

1. The first is a cluster of sites around the margins of a sandy flat, between quartzite ridges, 500m west of Worrill's Pass (Figure 2A). There are six rockshelters with rock art here (GT1-3, 7-9). Three contain substantial assemblages of painted, printed and stencilled art, and occupation deposit. These include the painting Giles described as 'Roman numerals' (see Figure 10). Chipped stone artefacts and fragments of grindstones, including seed-grinding implements, litter the sandy flat.
2. The second cluster of sites (GT 4-6, 10-13) (Figure 2B) is 2.6km west of Worrill's Pass in the upper reaches of the western-most channel. There are four small rockshelters with painted and stencilled motifs here (GT1, 4, 6, 10, 11). GT5 and GT12 are open engraving sites. GT13, a shallow overhang, contains a small assemblage of engraved track motifs and two hand stencils. The engravings at GT12 are on ledges and open rocky terraces around a rock hole (44m-long, 6m-wide and 0.75m-deep), which would hold a considerable volume of water. At the time of our visit in August 2004, just a month after heavy local rains, the waterhole was already dry (although the muds were still damp, attracting masses of butterflies). We also noted extensive artefact scatters on rocky terraces above the waterhole.
3. The third cluster of sites (Figure 2C) is 3km northwest of Worrill's Pass, along the upper reaches of the creek that flows south through the pass. There are several waterholes in the bed of the creek here, a worked outcrop of pedogenic silcrete, and scatters of chipped stone artefacts on the terraces and nearby flats.



Figure 3 Excavations at Glen Thirsty 1, August 2004, looking southeast (L to R: Mike Smith and Sharon Overend) (Photograph: M.A. Smith).

There were few signs of Aboriginal occupation on the sand plain adjacent to Giles' well, or on dunes to the south.

Our fieldwork in 2004 focused on four aspects of Glen Thirsty:

- archaeological excavation of two rockshelters (GT1 and GT3);
- further recording of rock paintings and rock engravings, especially in the western cluster;
- sampling of stick-nest rat middens to provide palaeo-environmental data on the pre-European vegetation of the area; and
- a search for remains of Giles' 1872 camp.

A third rockshelter with archaeological deposit (GT2) was not excavated at the request of the senior Aboriginal custodian (the late Syd Coulthard) who was a member of the field party. Excavation methods followed Johnson (1979) and are described more fully in Smith (1988). Recording of the paintings and engravings followed the approach developed by Rosenfeld and Smith (2002), where motif counts include compositions made up of multiple graphic elements. This gives lower motif counts than methods that break these down into individual graphic elements.

Archaeological Excavations

Glen Thirsty 1

Glen Thirsty 1 is the largest of the rockshelters in this locality (Figure 3). It faces north, opening directly onto the sand plain. Structurally, the shelter is a cavity developed along joint lines beneath horizontally bedded quartzite in the Winnall Beds (a white or brown sandstone), to create a habitable shelter 10m-long by 7m-wide, with a roof height of 2.5m (Figure 4). Several large panels of paintings cover the walls and roof of the shelter. Occupation debris, visible on the surface of the floor deposits, includes small pieces of dark red ochre, large pieces of charcoal, chipped stone artefacts, seed-grinding implements (including a broken millstone and several intact mullers) and numerous small fragments of broken grindstones. Outside the overhang, occupation debris extends out from the shelter for about 10m.

Excavation of a small trench (2 x 1m² pits, designated F6 and F7 on a nominal site grid) showed a sedimentary sequence approximately 1m-thick, consisting of an upper unit (20cm-thick) with stone artefacts, fragmented bone, ochre, charcoal and interleaved ashy lenses, overlying a unit of colluvial sand and roof fall (60-80cm-thick), and bedrock. Tables S1-S3 (supplementary information) provide details of sieve and granulometric data, and depths of individual excavation units.

Stratigraphy and Sedimentary History

The stratigraphy at Glen Thirsty 1 shows a mantle of late Holocene occupation deposit covering a sandy soil, in which the upper part of the profile contains a few stone artefacts together with evidence of widespread burning of local vegetation.

The deposits consist of three layers (Table 1, Figure 5). Layer I is a loose light brown sand with large charcoal pieces (up to 20mm) and other occupation debris. This overlies a more consolidated unit of ashy grey sand with intact hearths (Layer II), representing the major occupation of the rockshelter. Layer II overlays colluvial sands (Layer III), which grade from a black sand (Munsell 7.5YR 2/3, pH 4.5) rich in finely comminuted charcoal to brown (Munsell 7.5YR 3/3), becoming lighter with depth (Layer V). The major source of sediments appears to be weathering of local quartzite, both within the rockshelter and along the foot of the strike ridge. The fine red aeolian sand that mantles the sand plain in front of the rockshelter has not significantly contributed to the rockshelter deposits. A band of roof spall and rock fall marked the top of the colluvial sands, protecting deeper deposits from disturbance.

The black sand is unusual in Central Australia and requires some explanation. At 0.35% the net organic carbon content of Layer III (at 30cm below surface) is within the normal range for arid zone soils (Jackson 1962:44). However, flotation and filtration of these sediments shows the carbon is in the form of abundant fine charcoal particles (<100µm), suggesting burning of local grassland immediately prior to major occupation of the rockshelter.

Our excavations reached bedrock in F7. The F6 pit came down on a large rock slab that stopped further excavation. Both

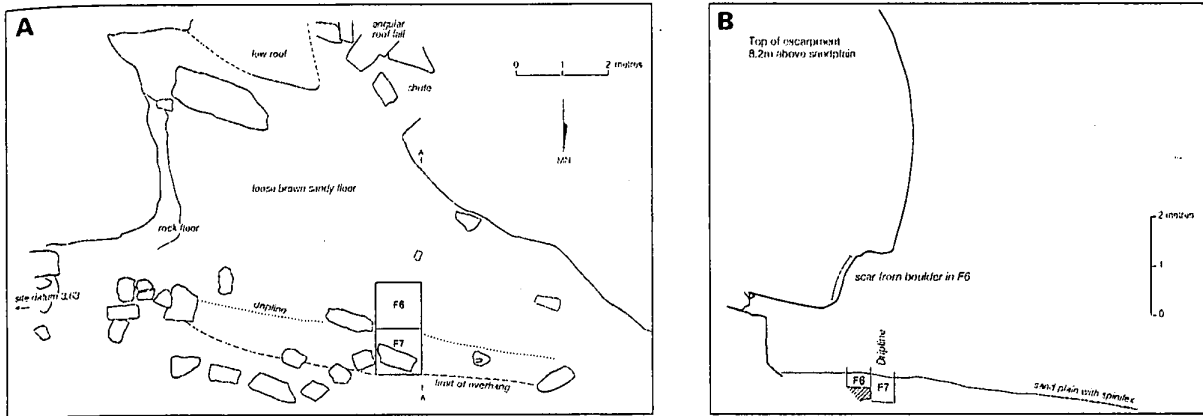


Figure 4 (A) Plan of Glen Thirsty 1. A-A' indicates position of cross-section shown in Figure 4B. (B) Site profile.

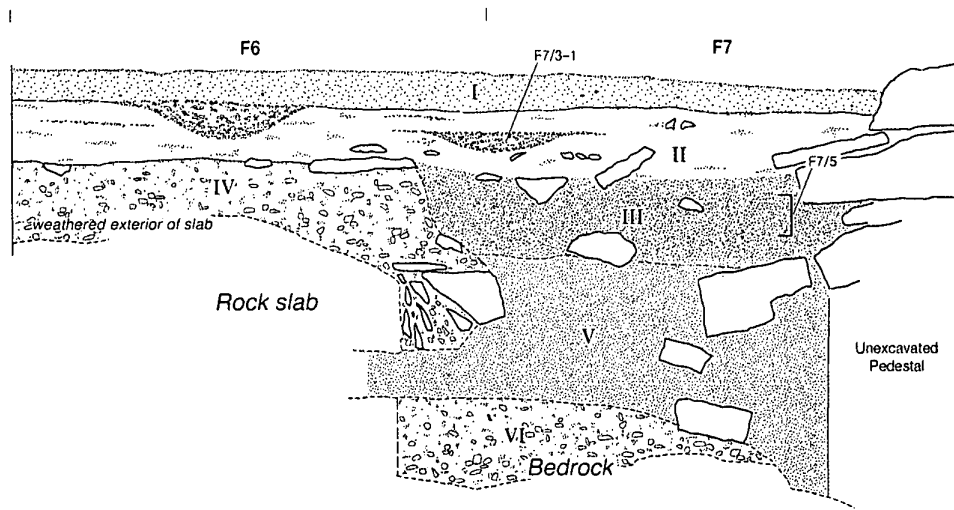


Figure 5 Stratigraphic cross-section, west face of Trench F6/F7, Glen Thirsty 1. Layers I-VI are described in the text.

Table 1 Composition of the rockshelter deposits, Glen Thirsty 1 and 3. Figures for charcoal, lithics and bone are standardised by gross weight of excavated sediment.

Site	Layer	Rocks/Rubble (%)	Fine Gravel (%)	Charcoal >3mm (g/100g)	6mm Lithics (#/100g)	3mm Lithics (#/100g)	Ochre >6mm (g)	Bone >3mm (g/kg)
GT1	I & II: Main occupation unit	26	2	61.0	220	30	13.5	5.3
GT1	III: Black sand	66	4	1.3	30	1	-	0.2
GT1	V: Brown sand & rubble	53	7	-	-	-	-	-
GT3	I & II: Occupation unit	4	2	67.3	160	52	1.1	18.5

Table 2 Radiocarbon dates for Glen Thirsty 1 and 3. Radiocarbon ages were calibrated using OxCal 4.0 (Bronk Ramsay 1995, 2001) and the SHCal04 (McCormac et al. 2004) dataset.

Site	Layer	Context	Depth (cm)	Lab No.	¹⁴ C Age (years BP)	Calibrated Age BP 1σ	Calibrated Age BP 2σ	Material Dated
GT1	II: Main occupation unit	F7/3-1	16	Wk-16359	1300±38	1270-1090	1280-1070	Charcoal from hearth
GT1	III: Top of black sand	F7/5	27-37	Wk-18696	1715±32	1610-1520	1700-1410	Detrital charcoal (6 & 3mm)
GT3	II: Occupation unit	E2/3	6-13	Wk-18697	272±30	320-150	440-150	Detrital charcoal (>6mm)
GT3	II: Occupation unit	E3/3-1	16	Wk-16358	235±35	300-150	320-10	Detrital charcoal in hollow on bedrock (6 & 3mm)

bedrock and the rock slab were friable and deeply weathered, so much so that excavation cut through their original exterior surfaces into an orange sand representing *in situ* disintegration of the sandstone (IV and VI, Figure 5). The rock slab at the base of F6 can be matched to a prominent scar on the lip of the rockshelter, providing a *terminus post quem* for the rock paintings that now cover the scar.

Chronology

Two radiocarbon samples were submitted from this site (Table 2): Wk-16359 (1300±38 BP) on charcoal from an intact hearth (F7/3-1) in the middle of the ashy occupation unit (Layer II), and Wk-18696 on detrital charcoal recovered by flotation from F7/5 to date the top of the black sand (1715±32 BP). The two radiocarbon samples bracket the base of Layer II, showing that it began to accumulate about 1500 years ago, consistent with the presence of late Holocene implement types such as seed-grinding implements, tula adze slugs, and geometric microliths. The base of the rock slab in F6 rests on deposits that are estimated to date between 2000–3000 BP.

Chipped Stone Artefacts

The distribution of chipped stone artefacts is shown in Tables 1 and 3. The concentration of artefacts in Layers I and II is striking. There are fewer artefacts in the underlying sands (Layer III). Although most of these are in the top of the black sand (F6/7 and F7/5), the presence of a band rocks and roof

spall seals the deposit at this level, and suggests that these are likely to be *in situ*. Some corroboration of this is provided by the presence of small amounts of bone and fine chipping debris in these levels. The lowest artefacts are from the top of F7/6 (36cm below surface) where the black sand grades into lighter sediments. Artefacts recovered from F6/6 represent material from pockets on the surface of the rock slab, or displaced by treadage into the orange sand that results from *in situ* decay of this rock.

Chert or cherty silcrete is the dominant raw material, making up 52% of this assemblage (Table 4). The most common variety is mottled buff chert. Pedogenic silcrete (a yellow-grey cherty silcrete) is available in worked outcrops 3km northeast of the rockshelter, but is not represented significantly in the excavated assemblage. Local quartzite makes up the balance of the artefacts (47%). The white chalcedony, and red or yellow nodular cherts found in the Puritjarra assemblage (Smith 2006) are rare at Glen Thirsty.

Tables 5 and 6 show the distribution of artefact classes and tool types. The assemblage is dominated by small flakes (up to 15mm) with comparatively few cores or debitage. Retouched artefacts are expediently retouched (amorphous) implements or are broken pieces of larger implements, often elements snapped off a retouched edge. Tool types are characteristic of late Holocene assemblages elsewhere in Central Australia, with tula adzes (or tula slugs), geometric microliths, thumbnail scrapers and endscrapers as the main formal artefacts.

Table 3 Distribution of artefacts and occupation debris at Glen Thirsty 1. Data are for 6mm fraction unless indicated otherwise.

Layer	XU	Chipped Stone Artefacts					Grind stones	Ochre		Bone		Nuts	Charcoal
		Total Weight	n	Mean Weight	Artefact Density	Flakelet Density (3mm)		6mm	3mm	6mm	3mm		
		(g)	(#)	(g)	(#/kg)	(#/100g)		(#)	(g)	(g/kg)	(g)		
Layer I	F6/1	296.2	120	2.5	3.3	21	2	0	0	3.4	9.1	0.7	308
	F6/2	233.6	155	1.5	3.0	23	0	1.6	0	9.5	10.7	0.5	147
Layer II	F6/3	112.8	85	1.3	1.4	26	1	0	0	4.0	14.4	0	112
	F6/4	171.5	122	1.4	1.7	25	0	0.4	0.2	3.5	10.6	0	85
	F6/5	194.4	305	0.6	2.8	20	0	0	0	0.3	1.2	0	80
Layer IV	F6/6	151.1	74	2.0	0.5	2	0	0	0	0	0	0	14
Layer III	F6/7	7.9	2	4.0	0.1	1	0	0	0	0	0	0	2
Layer I	F7/1	291.6	151	1.9	1.7	26	1	0.8	0	2.4	2.6	0	12
	F7/2	441.0	301	1.5	2.8	32	0	0	0	1.1	1.5	0	10
Layer II	F7/3	687.7	75	9.2	0.7	58	0	10.1	0.2	0	0.2	0	5
	F7/4	645.5	277	2.3	2.6	34	0	0.6	0	0	0	0	3
Layer III	F7/5	194.4	68	2.9	0.4	11	0	0	0	0	0.2	0	1
Layer V	F7/6	56.9	1	56.9	0	1	0	0	0	0	0	0	3
	F7/7	0	0	0	0	0	0	0	0	0	0	0	0
Layer VI	F7/8	0	0	0	0	0	0	0	0	0	0	0	0

Table 4 Raw material use at Glen Thirsty 1 and 3. Data are percentage frequency of artefacts of each raw material.

Site	Layer	n	% Char	% Quartzite	% Ironstone	% Chalcedony
GT1	I & II Main occupation	557	52.2	47.4	0.2	0.2
GT3	I & II Occupation unit	294	66.0	29.9	0	4.1

Grindstones

The excavation recovered four pieces of grindstone, all except one from the loose surface sand (Layer I). None of these can be securely identified as seed-grinding implements, although millstones and mullers are found on the surface of the site, as well as on the sand plain in front of the rockshelter.

Ochre

Pieces of ochre were found throughout the ashy grey occupation unit, with most coming from F6/4 and F7/3 (for details see Table S4, supplementary information), a level directly dated by Wk-16359. Several different ochres are represented. The most common (8 of the 10 pieces recovered) is a fine-grained, bright red ochre. This relatively homogenous pigment is found either as small subangular fragments, or as intact pisoliths (up to 15mm diameter). The latter suggests a source in Tertiary laterites or ferricretes, such as those formed over the Goyder formation on the Watarrka plateau (Bagas 1988). F7/3-2 is a piece of ground ochre with the distinctive coarse-grained texture, purple colour and metallic lustre of material from the Ulpnyali quarry, 50km northeast of Glen Thirsty. A single piece of fine-grained dark red micaceous ochre (possibly Karrku ochre) was recovered from F7/1.

Seeds

Fragments of quondong nuts (*Santalum acuminatum*) are present in the loose surface sand (Layer I), suggesting occupation during September or October (when the fruits ripen, depending on rain)(Table 3).

Bone

Table 3 shows that bone is restricted to Layers I and II (except for a single small piece in F7/5). The bone mainly consists of fragments of postcranial bone <30mm-long, ranging from the hard compact bone of large macropods to the epiphyses of small-medium mammals, to complete bones of small rodents and lizards. Identifiable elements include tooth fragments of medium-large macropods (including tooth enamel from molars and lower incisors), the maxilla of a rodent, reptile vertebral elements, and the dentaries of small agamid (5) and scincid lizards (1). Of the larger bone, some pieces are scorched, charred or calcined.

Glen Thirsty 3

Excavations at rockshelter GT3 revealed a similar assemblage to GT1, but one with a more limited chronology, which contrasts with its comparatively rich assemblages of paintings and chipped stone artefacts.

Glen Thirsty 3 is 370m northwest of GT1, on the northern side of a low quartzite strike ridge. It is a low rockshelter, 12m-long by 3m-wide, with a sloping roof 1-2m high (Figure 6), facing out onto a mulga flat. The rear wall of the shelter has a prominent frieze of paintings, now covered in dust. Exterior deposits around the shelter are subject to gentle slope-wash, and because of this have a relatively high concentration of chipped stone artefacts (~500/m²). The only identified types are tula adze slugs of which several were noted. Seed-grinding implements and other grindstones are rare at this site.

Table 5 Composition of the flaked stone assemblage at Glen Thirsty 1. Data are numbers of artefacts (6mm sieve fraction) in each category. Wall cleaning is material recovered from F6/1 and /2 and F7/1 and 2.

Layer	SU	Retouched Artefacts	Unmodified Flakes	Cores	Debris	Total
Layer I	F6/1	12	38	0	75	125
	F6/2	10	65	0	76	151
Layer II	F6/3	4	36	0	43	83
	F6/4	7	32	1	77	117
Layer IV	F6/5	12	86	0	182	280
	F6/6	3	39	0	30	72
Layer III	F6/7	0	2	0	0	2
Layer I	F7/1	9	56	0	80	145
	F7/2	12	113	1	172	298
Layer II	F7/3	20	122	1	157	300
	F7/4	16	107	1	154	278
Layer III	F7/5	3	46	0	19	68
Layer V	F7/6	0	2	1	2	5
Layer I	Wall cleaning	10	13	0	23	46
Total		118	757	5	1090	1970

Table 6 Temporal distribution of flaked tools at Glen Thirsty 1. Data are numbers of artefacts (6mm sieve fraction) in each category.

Layer	SU	Geometric Microliths	Tula Adze Slugs	Thumbnail Scrapers	Endscrapers	Amorphous Retouched Implements
Layer I	F6/1	0	2	0	0	10
	F6/2	1	3	0	0	6
Layer II	F6/3	0	1	0	1	2
	F6/4	0	1	0	0	6
Layer IV	F6/5	1	1	1	0	9
	F6/6	1	0	0	0	2
Layer III	F6/7	0	0	0	0	0
Layer I	F7/1	0	2	0	0	6
	F7/2	0	2	1	0	9
Layer II	F7/3	1	4	1	2	12
	F7/4	2	2	0	0	12
Layer III	F7/5	0	0	0	0	3
Layer V	F7/6	0	0	0	0	0
Layer I	Wall cleaning	0	2	0	0	8
Total		6	20	3	3	85

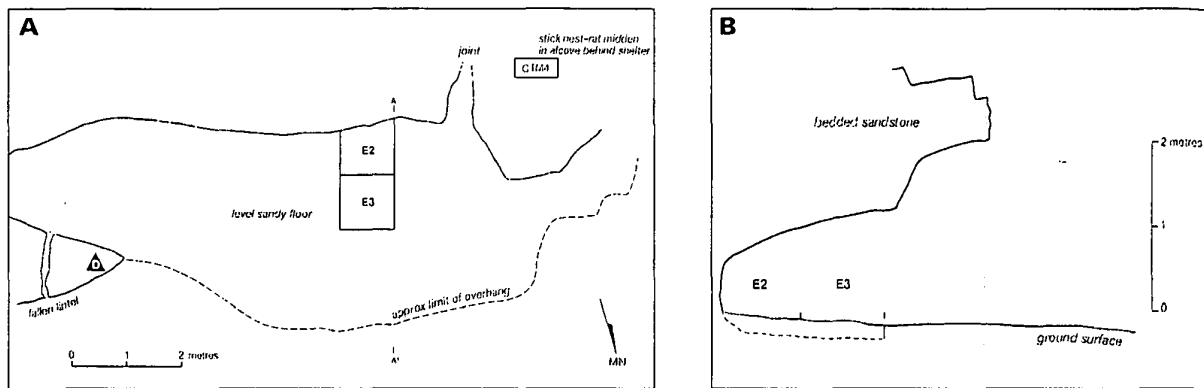


Figure 6 (A) Plan of Glen Thirsty 3. A-A' indicates position of cross-section shown in Figure 6B. (B) Site profile.

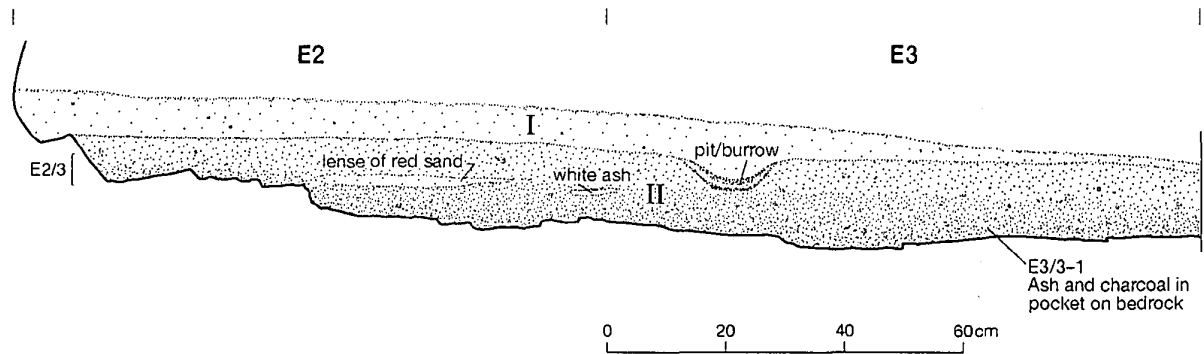


Figure 7 Stratigraphic cross-section, west face of Trench E2/E3, Glen Thirsty 3. Layers I and II are described in the text.

Excavation of two 1m² pits (E2 and E3) showed that the archaeological deposit forms a shallow wedge of sandy sediment (20cm-thick) resting on bedrock. Tables S5-S7 (supplementary information) provide details of sieve and granulometric data, and depths of individual excavation units.

Stratigraphy and Sedimentary History

The deposits consist of two layers (Table 1, Figure 7). Layer I is a loose red aeolian sand (Munsell 5YR 4/8) (6cm-deep), abundant in chipped stone artefacts, fragmented bone, charcoal pieces and macropod scats. Layer II is a more compact form of the same sediment becoming darker and more grey with depth, with some small discrete lenses of red sand or white ash. In both layers, the sediment matrix is aeolian sand. The sandy loam on the mulga flat in front of the shelter does not appear to have contributed significantly to the rockshelter deposits.

Chronology

Two radiocarbon samples were submitted from this site (Table 2). Wk-16358 (235±35 BP) dates charcoal resting in a hollow on bedrock (E3/3-1) at the base of the deposit. Wk-18697 (272±30 BP) dates a larger sample of detrital charcoal from E2/3, 4cm above bedrock (6-13cm below surface). Calibration of these radiocarbon ages indicates the deposit began to accumulate between AD 1630-1800, suggesting that use of this shelter overlaps Giles' visit in 1872.

Chipped Stone Artefacts

The distribution of chipped stone artefacts is shown in Tables 1 and 7. The highest concentration is in Layer 1, but

artefact density is high throughout the deposit, with more fine debitage than at GT1. As at GT1, chert or cherty silcrete is the dominant raw material, making up 66% of this assemblage (Table 4). Again, the most common variety is mottled buff chert. Local quartzite makes up 30% of the artefacts, and there is also some chalcedony (4%). Tables 8 and 9 show the distribution of artefact classes and tool types. The assemblage is dominated by small flakes (>15mm), with a higher proportion of debitage than GT1. Retouched artefacts are mainly expediently retouched (amorphous) implements or are broken pieces of larger implements, often elements snapped off a retouched edge. Tula adzes (or tula slugs), geometric microliths, thumbnail scrapers and endscrapers are the main formal artefacts.

Grindstones

Only one grindstone was recovered during excavation. E3/1-1 is a small flake off a grindstone.

Ochre

Only three pieces of ochre were recovered from GT3 (Table S7, supplementary information), all from unconsolidated surface sediments (Layer 1). Two of these are a fine-grained, bright red ochre, matching the most common ochre at GT1. The remaining piece is a friable orange sandy ochre, probably from local sandstone beds.

Seeds

Fragments of quondong nuts (*Santalum acuminatum*) are present in the upper 13cm of the profile.

Bone

Finely fragmented bone is common throughout this deposit (Table 7). As with GT1, this mainly consists of fragments of postcranial bone from small-medium-large mammals. The few identifiable elements include tooth fragments of medium-large macropods (including the crowns of molars), the claw of a large macropod, rodent incisors, and parts of mandibles of small mammals. Two bones, both segments of long bones from medium-sized mammals, have distinct cut-marks.

The Rock Art

Giles' descriptions of the rock art at Glen Thirsty (and at the 'Tarn of Auber') provide the earliest written records of the rich corpus of rock art in Central Australia. Glen Thirsty, he wrote, was 'the

aboriginal national gallery of paintings and hieroglyphics' (Giles 2000[1875]:69) and he was particularly struck by the large emblematic motifs at these sites, commenting that 'rude figures of snakes were the principal objects, but hands, and devices for shields were also conspicuous' (2000[1875]:65). (His use of the phrase 'devices for shields' suggests he read some of these paintings as heraldic motifs).

Our survey identified 13 rock art sites: 11 with painted, drawn, stencilled or printed art, and three with engravings. Figure 8 illustrates the range of painted motifs. Table 10 gives the relative density of art at these sites, showing that the eastern sites (especially GT1-3) have been the focus of pigment art production, while the western sites contain all the engravings.

Table 7 Distribution of artefacts and occupation debris at Glen Thirsty 3. Data are for 6mm fraction unless indicated otherwise.

Layer	XU	Chipped Stone Artefacts					Grind-stones	Ochre		Bone		Nuts	Charcoal
		Total Weight	n	Mean Weight	Artefact Density	Flakelet Density (3mm)		6mm	3mm	6mm	3mm		
		(g)	#	(g)	#/kg	#/100g		#	(g)	(g/kg)	(g)		
Layer I	E2/1	251.1	141	1.8	2.6	56	0	0	0.2	2.1	14.2	1.2	81.9
	E2/2	97.3	86	1.1	1.4	39	0	0	0.2	1.3	18.5	0.6	92.2
Layer II	E2/3	33.3	47	0.7	0.6	62	0	0	0	0.9	21.2	2.0	53.1
	E2/4	21.7	17	1.3	0.5	18	0	0	0	0	9.3	0	15.6
Layer I	E3/1		332	1.2	3.1	63	1	0.9	0	13.9	18.3	4.5	85.0
Layer II	E3/2	132.9	86	1.5	1.0	66	0	0	0	5.2	23.6	0	99.6
	E3/3	58.0	51	1.1	1.3	38	0	0	0	0.6	17.4	0	3.8

Table 8 Composition of the flaked stone assemblage at Glen Thirsty 3. Data are numbers of artefacts (6mm sieve fraction) in each category.

Layer	XU	Retouched Artefacts	Unmodified Flakes	Cores	Debitage	Total
Layer I	E2/1	9	33	0	99	141
	E2/2	3	34	0	49	86
Layer II	E2/3	1	23	0	23	47
	E2/4	1	12	0	4	17
Layer I	E3/1	11	99	0	222	332
Layer II	E3/2	1	47	0	38	86
	E3/3	2	25	0	24	51
Total		28	273	0	459	760

Table 9 Temporal distribution of flaked tools at Glen Thirsty 3. Data are numbers of artefacts (6mm sieve fraction) in each category.

Layer	XU	Geometric Microliths	Tula Adze Slugs	Thumbnail Scrapers	Endscrapers	Amorphous Retouched Implements
Layer I	E2/1	0	3	0	0	6
	E2/2	1	0	0	1	1
Layer II	E2/3	0	0	1	0	0
	E2/4	0	1	0	0	0
Layer I	E3/1	0	0	0	0	10
Layer II	E3/2	0	0	1	1	0
	E3/3	0	1	0	1	1
Total		1	5	2	2	18

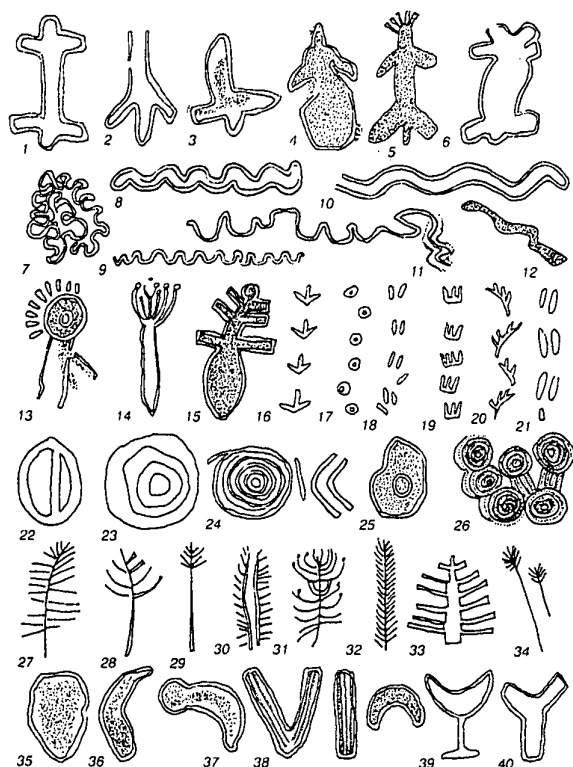


Figure 8 Composite drawing illustrating the range of painted motifs at Glen Thirsty. (1-3, 6) White outline or bichrome silhouette motifs. (4-5) Anthropomorphic motifs. (7-12) Sinuous line ('snake') motifs, either white outline (7-8, 11), or monochrome. (13-15) Other complex motifs. (16-21) Trails of tracks, including bird (16), possum (19-20) and macropod (18, 21). (22-26) Circles including barred (22), concentric (23-25) and conjoined variants (26). (27-34) Fern motifs. (35-37) Irregular bichrome motifs. (38) Giles' 'Roman numerals'. (39-40) Y motifs.

Overall, this rock art complex provides a strong comparative assemblage for those at Watarrka to the northeast (Frederick 1999; Rosenfeld 1990; Ross 2003; Smith and Rosenfeld 1992) and Puritjarra to the north (Rosenfeld and Smith 2002; Ross 2003). Although the Glen Thirsty assemblage has a broader range of motifs than either Puritjarra or Watarrka, the greater proportion of the motif vocabulary, the colour range utilised and the method of applying the pigment is similar. The context and physical organisation of the sites at Glen Thirsty is also similar to other rock art complexes in Central Australia (Gunn 1995, 2000) where each complex is associated with a water source, however ephemeral, and each is made up of one or two major sites with a number of smaller satellite sites containing fewer motifs.

Glen Thirsty 1

In addition to hand stencils and hand prints, the main motifs at Glen Thirsty 1 include trails of macropod or possum tracks (track lines or meanders), monochrome sinuous or bichrome/white outline 'snake' motifs, and concentric circles (Table 11, Figure 8). Most motifs are painted, though other techniques such as stenciling, printing and drawing are also evident. Red (22) or dark red (21) ochre were the most frequently used colours, although white, cream, black, pink, yellow and grey pigments were also recorded.

Large 'snake' motifs (~2m-long) dominant the painted frieze at Glen Thirsty 1. Three large monochrome snakes, painted as either white outline (silhouette) or solid red, occupy the back wall of the shelter. Although anatomical details are not shown, Peter Bullah identified these as 'kuniya' or large python. At the front of the shelter, on the overhang above the excavation, a monochrome snake in dark red ochre has been painted over an earlier bichrome white-outline/red infill snake and appears to have been repainted on at least one occasion (as it is interlaced with a bichrome white-outline 'inverted T-shape' motif) (Figure 9).

Other prominent paintings in white pigment include a large concentric circle (58cm diameter) with four irregular rings and a white-outline 'lizard' motif (identified by Peter Bullah as relating to the blue-tongue lizard [*Tiliqua multifasciata*], his personal totem). The similarity in both the method of pigment application and the colour and consistency of the ochre used to produce these paintings suggests they represent a single painting episode.

Macropod trails and tracks are represented by paired parallel dashes, which meander along the rear wall of the shelter following natural features. Peter Bullah identified the most prominent of these as *mala* (*Lagorchestes hirsutus*). He identified others made up of diagonally opposed feather-like motifs as possum (*Trichosurus vulpecula*) tracks. Several longer trails have been extended using different pigment, indicating either repainting of these motifs or use of discrete batches of pigment during their creation.

Hand stencils and hand prints have been placed individually on panels, rather than in pairs or clusters. No hand prints or stencils of children were recorded here or at other sites.

On several panels, fine drawings in charcoal form clusters of short irregular vertical lines, or concentric arcs.

Relative Sequence

The superposition of motifs indicates changes in the composition of this frieze over time, although there is no consistent temporal sequence in the use of different coloured pigments.

Table 10 Composition of rock art assemblages at Glen Thirsty. Data are motif counts by composition (ordered arrangements of several graphic elements).

Site	1	2	3	4	5	6	7	8	9	10	11	12	13
Hand stencils	12	7	1	0	0	0	2	3	1	0	4	0	2
Hand prints	2	1	17	0	0	4	0	0	0	0	1	0	0
Paintings	63	116	76	2	0	0	2	0	3	21	17	0	0
Drawings	3	7	9	0	0	0	0	0	0	0	9	0	0
Engravings	0	0	0	0	2	0	0	0	0	0	0	272	3
Total	80	131	103	2	2	4	4	3	4	21	31	272	5

- Yellow or white hand prints, and trails of macropod or possum tracks in red or yellow ochre, represent the most recent art at this site. Individual tracks within some trails are outlined in charcoal, a practice associated with very recent rock art assemblages in Central Australia (Frederick 1999; Ross 2003, 2005). The rough wash technique used to apply the pigment on two large white motifs, and their placement over a pair of yellow macropod tracks indicates that these motifs also belong to this phase.
- Hand stencils and individual or paired macropod tracks repeatedly occur under other motifs so are likely to form part of the earliest assemblage at this site.
- The large 'snake motifs' represent a phase of art production lying between the earliest and latest art at this site. Snake motifs overlie hand stencils or large arc motifs but consistently occur under hand prints and trails or lines of tracks. Some of these motifs influenced the placement of later art. On the rear wall, a trail of possum tracks runs parallel with a monochrome red snake, suggesting this retained significance into the recent past.

Glen Thirsty 2

This shelter contains the greatest concentration of pigment art at Glen Thirsty (Tables 10-11) and there are several striking features of the art assemblage. The first is the high proportion of motifs that have been painted using two or more colours (20 out of 131). Most have an outline, frequently painted in thick white pigment with an infill of red, red/purple, or most commonly, dark grey ochre. Most are large motifs; the largest of these (~1m²) consists of six linked concentric circles painted in black and white pigment (Figure 8:26).

Giles' 'Roman numerals' are included in this group and comprise a large v-shape and line, outlined in white and infilled with parallel lines of white and dark grey pigment (Figures 8:38, 10). Giles described this motif as 'daubed over

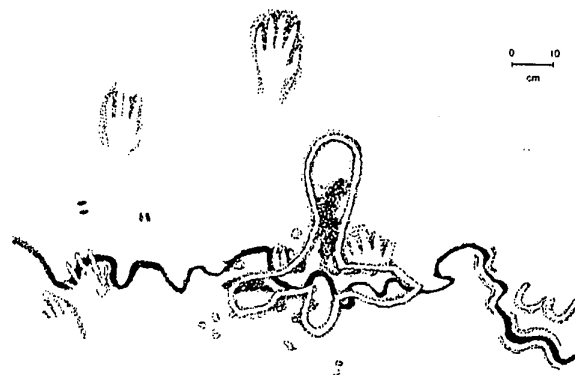


Figure 9 Art panel at Glen Thirsty 1, showing a white-outline, black infill motif overlying a red monochrome snake. The latter has been painted over an earlier bichrome white-outline/red infill snake (lower right).

with spots' and 'painted with red ochre' (2000[1875]:65). As there is no evidence of repainting since 1872, we think Giles must have added these details from memory when revising his journal for publication in his 1875 report, conflating other details of the art panel (his original field journals are lost). For instance, the entire surface of a lower panel is daubed with spots of white paint.

The second feature is the presence of a diverse suite of large, irregular, white motifs (>50cm at the highest or widest point) (Figure 8:4-7, 10, 25, 35-37) not commonly found in art assemblages further east (cf. Gunn 1995, 2000). The majority of these have no recognisable iconic form and are best described as irregular enclosed shapes (though there is one 'snake' motif, and two others are anthropogenic in form).

White is the most frequently used pigment at this site (44 motifs). Dark red (40) and red (14) were also widely used, and we recorded a variety of other colours.

Table 11 Recurring motifs in paintings and engravings at Glen Thirsty. Data are motif counts by composition rather than graphic element. (1) Includes single or paired tracks. (2) Track lines, clusters or meanders, including bird, macropod, possum and other. (3) Includes plain circles, concentric circles, barred ovals, conjoined ovals and spirals.

Category	GT1	GT2	GT3	GT12
<i>Tracks</i>				
Macropod (1)	10	11	1	75
Bird	0	15	2	36
Trails (2)	28	37	31	29
<i>Formal motifs: Basic forms</i>				
Sinuuous line	3	2	7	0
Arc	2	0	0	6
Circle (3)	9	31	8	71
Fern	2	4	6	2
Amorphous shape	0	3	0	4
Y-shape	0	3	0	0
Linear	2	9	13	4
<i>Formal motifs: Composite forms</i>				
Bichrome snake silhouettes	1	1	0	0
Bichrome amorphous shape	4	8	0	0
Bichrome linked circle	0	1	0	0
Other complex	0	1	1	3



Figure 10 The late Syd Coulthard at Glen Thirsty 2, August 2003. The painted motifs include those described by Giles in October 1872 as 'Roman numerals' (Photograph: M.A. Smith).

Trails of tracks, including roughly executed trails of dots, extend across the shelter wall. Diagonal or short vertical trails of bird tracks contrast with longer meandering trails of macropod tracks. Characteristically, the macropod tracks were produced with fingers, using wet pigment to create a series of parallel tracks, whereas some possum tracks are notable in the delicate manner in which pigment has been applied.

Hand stencils are uncommon at Glen Thirsty 2, although there are traces of seven, adult, dark red hand stencils on an elevated panel.

Relative Sequence

Superposition analysis indicates that the suite of large bichrome paintings and white outline motifs are amongst the most recent produced at this site. Trails of tracks were added to the assemblage over time, but generally (9 cases) underlie the large white motifs. The active exfoliation on the surface of the rock art panels argues against any great antiquity for the assemblage at this site.

Glen Thirsty 3

This site has few formal motifs and an abundance of track lines, hand prints, and charcoal drawings (Table 11).

- Trails of tracks constitute 33% of this assemblage. Bird tracks typically form vertical trails, while trails of macropod tracks meander diagonally or horizontally across the shelter wall.
- Bichrome concentric circles and white fern-like motifs (averaging 30cm-high) are visually dominant amongst the formal motifs. One of these motifs has been repainted using the distinctive red/purple Ulpanyali ochre. Another larger motif consists of an oval with fern attached, painted in yellow pigment and outlined in black.
- We recorded a single faded hand stencil and 17 dark red hand prints (14 left hand, three right hand), all produced using the same dark red pigment and all representing the same (or similar) adult hand.
- This assemblage also includes a series of fine vertical lines, drawn in charcoal. These are widespread in western Central Australia (Ross 2003:223-224, 2005) and although

often dismissed as graffiti by rock art recorders in the past, there is growing evidence that they reflect a more structured practice.

Relative Sequence

Hand prints and charcoal drawings are the most recent motifs added to the assemblage at Glen Thirsty 3 as they are superposed on all motifs with which they overlap. Fine charcoal lines have also been used to outline older possum and bird tracks. Most tracks and trails are earlier in the superposition sequence and in turn overlay fern motifs and concentric circles.

The Engravings at Glen Thirsty 12

The engraved assemblage at Glen Thirsty 12 consists of 272 shallow pecked engravings on rock surfaces surrounding the adjacent waterhole. While most are placed on horizontal slabs on terraces running for 150m along the northern side of the waterhole, other engravings occur on the vertical faces of boulders on the southern side.

All motifs are relatively small in size and most rock faces have just a few motifs engraved into them. The range of motif classes at Glen Thirsty 12 (Table 11) is similar to that found at other Central Australian engraving sites. At Glen Thirsty, there is a predominance of bird and macropod tracks – either as individual tracks, paired tracks, or short trails, or as series of parallel dots. Pecked circles are small (<15cm diameter) and include plain circles, barred circles, concentric circles, spirals, in-filled circles, ovals and barred ovals. No figurative motifs are present but more complex designs include a small amorphous maze.

Several factors indicate that the engravings were produced over a relatively short period of time (possibly representing a discrete pulse of production): style and technique are consistent across the site; there is no superpositioning of engraved motifs on these panels; they are uniformly and only lightly patinated.

In addition to six shallow seed-grinding grooves, there are numerous small abraded patches (28) amongst the art panels (Figure S1, supplementary information), similar to those found at recent rock art complexes in the central ranges (Ross 2003:156-157). At Glen Thirsty, the abraded patches are comparatively small (averaging 44cm x 29cm) and are often juxtaposed with engravings. In most cases, the superposition order could not be reliably determined: some abraded patches were superimposed on engravings (3 examples) and one appeared to underlie an engraving. Mountford (1976:127; see also Strehlow 1947:17) recorded Aboriginal men in the Western Desert rubbing particular rock surfaces with hand-held stones as part of the reactivation of totemic sites. At Glen Thirsty, the size, placement and general context of abraded patches point to a similar practice, perhaps associated with both initial production and subsequent activation of the engravings. The clusters of peck marks (20) on many engraved surfaces may reflect a similar practice.

Chronology of Art Production

The occupation history of the two excavated rockshelters provides a broad temporal framework for the pigment art at Glen Thirsty, suggesting a maximum age of ~1500 BP for the art panels we see today. Correlation with sedimentary records is provided by several lines of evidence:

- Fragments of red or dark red, or Ulpanyali ochre, similar to the pigments used in the paintings and stencils are found throughout the occupation deposit at GT1 and 3.
- The fallen rock slab exposed in the excavations at GT1 provides an estimated *terminus post quem* of 2000–3000 BP for paintings and stencils on the related scar on the overhang. These include hand stencils that are amongst the earliest motifs produced at the site.
- There is broad agreement regarding the relative age of the sites, comparing occupation histories and phases of art production. For example, the rock art frieze at GT1 has the greatest intrinsic time depth of any of the 11 sites we examined – and this site also has the longest ¹⁴C chronology.

Within the last 1500 years, the Glen Thirsty sites show an internally-consistent series of changes in style and composition in the pigment art. Hand stencils and trails (mainly track lines or meanders) appear to have been the earliest compositions. These were followed by production of large emblematic motifs, including the white-outline silhouette designs at Glen Thirsty 1 and 2. The latest phase of art production at the Glen Thirsty sites consists of hand prints, charcoal drawings and paintings in white ochre. This sequence parallels similar changes at Puritjarra (to the north) during the last millennium (Rosenfeld and Smith 2002), especially the shift towards large emblematic motifs.

The engravings at Glen Thirsty are of no great antiquity and may be contemporary with the pigment art. The circles and tracks use the same stylistic conventions as the pigment art at Glen Thirsty. The shallow pecking technique used to produce motifs at Glen Thirsty 12 is similar to that used to produce many of the more recent engraved motifs across Central Australia (Ross 2002, 2003). Similarly, the range of motif classes recorded, the lack of patination, the absence of pecked pits, and the abundance of abraded areas, all suggest a recent age for this assemblage.

Historical Archaeology

No surviving trace of Giles' 1872 encampment was located. There are few trees of sufficient age and size to carry an old blaze. Extensive transects with a metal detector in the area south and southwest of Worrill's Pass, and on the flat south of the rock holes, failed to locate any metal items. It seems likely that Giles' use of Glen Thirsty was so light that little repair or discard of non-perishable objects such as horseshoes, or nails occurred. No metal objects were detected in the sandy floors of local rockshelters.

Vegetation History

Direct palaeoenvironmental evidence for the region is sparse (especially for the last few millennia). The phytolith record at Puritjarra (Bowdery 1995, 1998) shows that the mid-Holocene saw a decline in regional grass levels after 5000 BP, which only recovered again after about 1500 BP as the modern vegetation took shape. Assuming that periods of high representation of Poaceae in the phytolith record reflect better summer rainfall (which is likely), the last millennium was a comparatively favourable period for human settlement in Central Australia (Bowdery 1995:Figure 6.1). This is supported by a study of palaeofloods on the Todd River, Central Australia, which shows

frequent high-magnitude floods during the last 1500 years, with identified flood phases at 400 BP, 600 BP, 1000 BP and 2100 BP (Bourke 1998:131-134).

In Central Australia, stick-nest rat (*Leporillus* sp.) middens have also been used as a source of palaeoecological data. Berry (1991) sampled a midden at Kathleen Springs in Watarrka-Kings Canyon National Park, with results indicating little local vegetation change between 3500–1700 BP. Other *Leporillus* sp. middens, in the eastern MacDonnell Ranges show a marked late Holocene increase in tree and shrub taxa beginning sometime between 2510 and 850 BP, at the expense of herbs and grasses (Webeck and Pearson 2005). To test if there were comparable changes at Glen Thirsty, Webeck sampled four local *Leporillus* sp. middens in 2004. This work has yet to be completed, but preliminary results indicate that none of these middens date earlier than 430 BP and that over this period there is little apparent change in local vegetation.

Discussion and Interpretation

The History of Glen Thirsty

Our archaeological investigations give a picture of people using a small soakage well on the northern rim of Lake Amadeus. Despite our initial expectation that there would be several phases of major occupation at a site in this location, separated by periods of intermittent use or abandonment, we found that substantive occupation of Glen Thirsty only took place during the last 1500 years.

The presence of chipped stone artefacts in earlier deposits points to intermittent use of the area prior to this, but as visitation rather than colonisation. Some early use of the Glen Thirsty locale would be expected given its proximity to the George Gill Range with its springs and waterholes, and to Puritjarra with its long record of late Pleistocene occupation to the north. But Glen Thirsty itself only appears to have become an important focus of occupation after 1500 BP.

Analysis of the rock art assemblage – both engravings and paintings – leads us to similar conclusions: the rock engravings surrounding the waterhole are uniformly late prehistoric in their style and condition. There are no older weathered engravings to suggest that an earlier pulse of occupation in the Glen Thirsty area has been missed in the excavations. Other evidence supports an association between the paintings at Glen Thirsty 1 and 3 and the dated occupation deposits at these sites.

Several lines of evidence independently suggest establishment of a new cultural and economic landscape at Glen Thirsty around 1500 BP, although much necessarily remains speculative:

- Major use of Glen Thirsty 1 is preceded by widespread burning of local vegetation, coinciding with the first appearance of stone artefacts in these deposits. We have no data on whether this reflects human firing of local grassland (as Giles saw in 1872), or whether it represents large wildfires associated with increased fuel build up during years of exceptional rainfall (as Central Australia experienced in 2002-2003). But increased wildfires and increased occupation of Glen Thirsty would both be consequences of stronger summer rainfall.
- The rock engravings appear to represent a short-lived pulse of art production, consistent with the establishment of a more

sustained presence of people in the area and the assertion of new rights and associations to this place. This phase of art production appears to have been followed by an 'operational' phase during which the engravings were rubbed and abraded, presumably to reactivate them.

- An initial generic phase of painting and stenciling is followed by the painting of large site-specific iconic motifs at Glen Thirsty 1 and 2.
- Both the rock art and occupation histories of these sites suggest a gradual expansion of use of the area, with this use extending outwards from the initial focal areas around the waterhole (Glen Thirsty 12) and Glen Thirsty 1.

Once established, occupation of Glen Thirsty over the last millennium represents seasonal use of these desert lowlands, whenever rain reactivated the well or recharged local rock holes. Giles saw evidence of people using the well and firing the surrounding country in October 1872, after heavy rain had allowed people to disperse out into the spinifex and sand hill country. The presence of quondong nuts in excavations at Glen Thirsty also indicates some use of these sites in September or October.

Regional Context

Changes during the last millennium in Central Australia provide the regional context for developments at Glen Thirsty. To the north of Glen Thirsty, on the rim of the Amadeus Basin, both Puritjarra rockshelter and the Tjungkupu sites were occupied more intensively after 800–1000 BP. To the northeast, the major phase of use of Wanmara, a spring site in the George Gill Range, began c.1300 BP. In the main ranges, these changes also involved an expansion of Aboriginal settlement into the lower reaches of catchments, with increasing use of floodplains, ephemeral waters and sites on sand plain and valley floors (Thorley 1998a:317, 2001), greater use of grass and acacia seeds in the subsistence economy, and the budding off of clan estates into marginal areas (Smith 1988:325–332, 1996:70) (as also may have been the case at Glen Thirsty).

Although growing population pressure and shifts in patterns of land-use and economy would have provided much of the impetus for settlement of the Glen Thirsty area, the timing of this move is likely to have been constrained by climatic factors. Small shifts in the amplitude, frequency or seasonality of rainfall are important in determining levels of access to these desert lowlands (as the historical record for Glen Thirsty shows). As a rain-fed well in the lower part of the Amadeus Basin, Glen Thirsty is also more sensitive to shifts in palaeoclimate than archaeological sites on the Amadeus rim (such as Puritjarra and Tjungkupu) or in the main ranges (such as Kulpi Mara, see Thorley 1998b). In this context, any improvement in summer rainfall after 1500 BP (evident in vegetation and palaeoflood records) would have been important in recharging ephemeral wells and waterholes, underpinning more sustained use of this area. Poor as it was, the native well found by Giles was the key to development of Glen Thirsty as a focal point for rock art and Aboriginal occupation in this part of the Amadeus Basin.

At any one time, we can expect there to be core and peripheral areas of occupation in the Australian arid zone, with the boundaries changing as colonisation proceeds and people's

ability to use the desert landscape improves (cf. Veth 1993). The archaeology of Glen Thirsty exemplifies changing relationships between the ranges and desert lowlands during the last 1500 years, and shows that colonisation of the desert was not a discrete event but a long-term process that also involved consolidation of settlement in marginal areas in the last few thousand years.

Supplementary Information

Supplementary information for this article is available online at www.australianarchaeologicalassociation.com.au.

Acknowledgements

This project was supported by grants from AIATSIS (G2003/6832) and the Fund of the Dean of Arts and Humanities, University of New England, and was undertaken with permits from the Central Land Council and the Northern Territory Heritage Branch. In the field, we enjoyed the companionship of Peter Bullah and Syd Coulthardt (both now deceased). Logistical support for the 2004 excavations was provided by the Northern Territory Parks and Wildlife Service at Watarrka-Kings Canyon National Park and we thank Darren Larcombe and Andrew Bridges for organising this. Scott Mitchell and the Strehlow Research Centre generously provided bench space for preliminary analysis of excavated finds. Kim Webeck undertook analysis of the stick-nest rat middens and AMS ¹⁴C dates for these were provided by Stuart Pearson (Land and Water Australia). Stephen Cotter determined the organic carbon content of the sediments at Glen Thirsty 1. Figures were drawn by Kay Dancey (Cartography, Australian National University) and the authors. We thank all of the above and especially our field and support crew during the 2004 fieldwork: Danny Barrow, Tracy Blackney, Glenn Blackney, Shannon Carne, Syd Coulthardt, Rodney Coulthardt, Phillip Driffin, Sharon Overend, Sandy Walters and Kim Webeck.

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First published in *Australian Archaeology*, volume 66 (June, 2006).

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