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SHORT REPORT

Re-excavation of *Djuru*, a Holocene rockshelter in the Southern Kimberley, North Western Australia

Tim Maloney[a], Sue O'Connor[a], Dorcas Vannieuwenhuyse[b], Jane Balme[b] and Jane Fyfe[b]

[a]Department of Archaeology and Natural History, College of Asia and the Pacific, The Australian National University, Acton, ACT, Australia; [b]Archaeology M257, School of Social Sciences, University of Western Australia, Crawley, WA, Australia

ABSTRACT
Re-excavation of a shelter in Windjana Gorge National Park, Southern Kimberley has extended the known occupation sequence of the site from the mid Holocene to the terminal Pleistocene. The site was previously excavated in 1994 and a non-basal date of ~7,000 cal. BP was recorded. Significantly, the chronostratigraphic sequence represented in the earlier excavation is substantially different to the recent excavation demonstrating stratigraphic variation within a relatively small rock shelter and the need for extensive inter- and intersite and intra-site sampling prior to modeling regional occupation patterning.

ARTICLE HISTORY
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Introduction

In 2012 we re-excavated a rock shelter known by Bunuba traditional owners as *Djuru*, meaning outlying or projecting rock (June Oscar and Dillon Andrews pers. comm. 2012). The site is adjacent to the Lennard River in the Windjana Gorge National Park (Figure 1). It has been elsewhere reported as Windjana Gorge Water Tank Shelter (O'Connor et al. 2008) and Windjana Gorge 1 (Balme and O'Connor in press; Maloney et al. 2014). The site was initially registered in 1988 by Vinnicombe and Bradshaw, who described it as a large monolithic column of limestone detached from the range, with mythological associations, surface artefacts, deposit and rock art (DAA Site ID 12588). The monolith and surrounding boulders form two connecting shelters, each with deposit and art panels. The most westerly had a water tank placed within it that was removed in 1993, although associated disturbance such as a plastic water pipe is still visible and extends at least 40 m to the east, where it follows the drip line of the second shelter. It is within this second shelter that the 1994 and 2012 excavations were positioned (Figure 1).

In 1994, a 50 × 50 cm test pit (Square 1) was undertaken which produced a non-basal occupation sequence dating from ~7,000 cal. BP to the historical period (O'Connor et al. 2008). Square 1 produced a sequence with stone artefacts and well preserved faunal remains. In 2012, a 1 m^2 excavation was placed underneath the main rock art panel (Figure 2). The purpose of the re-excavation was to obtain a larger assemblage of archaeological material from the site as part of a regional archaeological project in the area.

2012 Excavation results

Square 2 was excavated in 2 cm excavation units [XUs] (average = 1.45, range = 0.85–2.166) within 50 × 50 cm quadrants. Stratigraphic changes and feature outlines were recorded during excavation. All sediment was dry sieved through 3 mm and 1.5 mm screens. Sediment samples were taken from each XU and from individually recorded features. Charcoal, shell and seeds to be used for dating were plotted in 3-D, as were large stone artefacts.

The deposit is composed predominantly of a matrix of calcitic silts and quartz fine sands originating from the surrounding limestone weathering and the alluvial plain. The sequence shows a complex layering with subtle changes in colour (light grey, brown to dark grayish brown) indicative of variable proportions of ashes, organic matter and charcoal (Figure 2). The layers have been grouped in eight main stratigraphical units [SUs]. Bioturbation has affected some areas of the deposit (burrows and roots).

The sequence in Square 2 is divided by a chronostratigraphic hiatus in two occupation phases: the 'early Holocene phase' and the 'late Holocene phase' (Table 1 and Figure 3). The lowest and earliest date of 13,051 to 12,759 cal. BP (D-AMS 001681) was obtained from a charcoal sample from directly over the decomposing limestone bedrock (transition SU8/7). Multiple radiocarbon dates bracket the early Holocene phase between 13,000 and 8,700 cal. BP

CONTACT Tim Maloney tim.maloney@anu.edu.au Department of Archaeology and Natural History, College of Asia and the Pacific, The Australian National University, Acton, ACT 2601, Australia

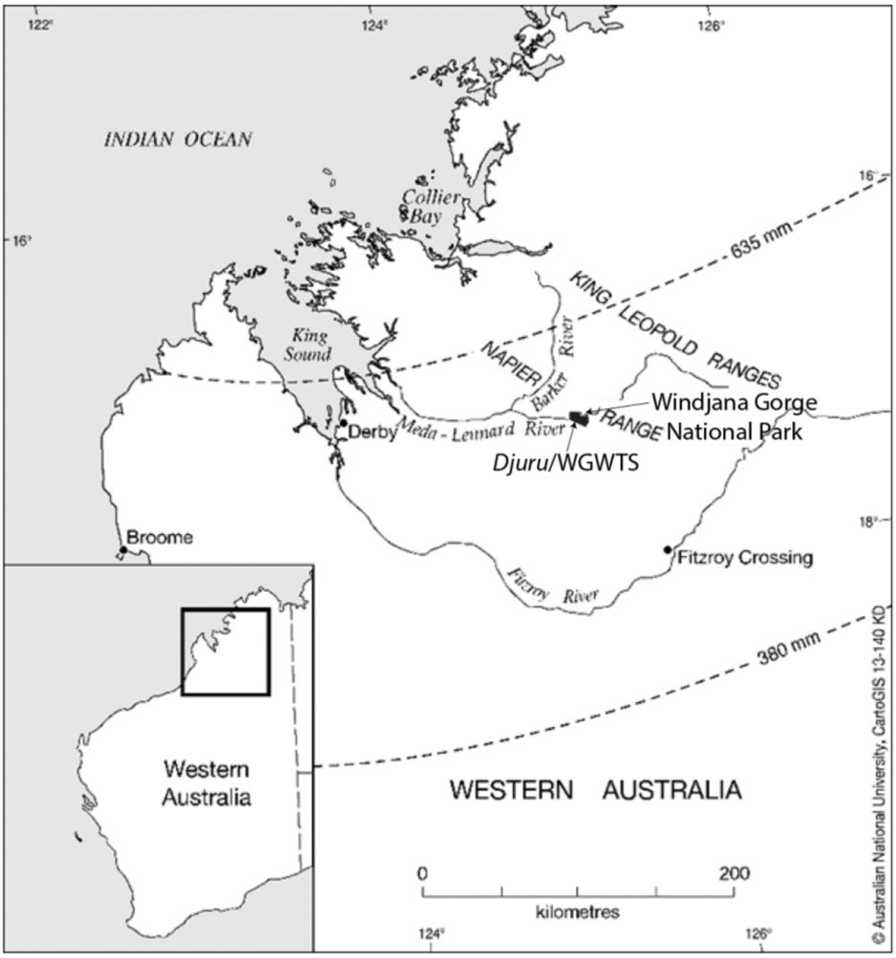

Figure 1. North Western Australia and Kimberley region showing Windjana Gorge National Park and *Djuru*/Windjana Gorge Water Tank Shelter (WGWTS) site location.

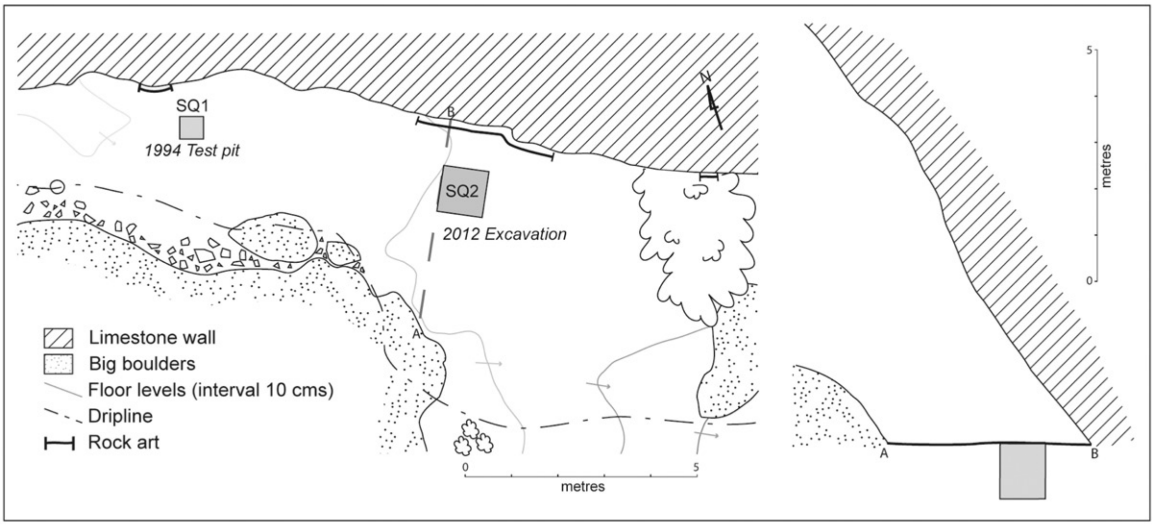

Figure 2. *Djuru* site plan and profile (Dorcas Vannieuwenhuyse).

(XU 52 to 15 and SU 8 to 5). All charcoal samples from SU 4 to 1 date within the last 1,300 years and decrease in age towards the surface. Some late Holocene dates are out of stratigraphical order and are not taken into account in our sequence (D-AMS 001670, D-AMS 001671, D-AMS 001672, D-AMS 001673). Thus the mid-Holocene occupation found in the previous excavation is not represented in this part of the deposit.

The 2012 excavation recovered bone, mussel shell, scaphopod beads and other marine shell fragments, charcoal, ochre, botanical remains, stone artefacts, and a single bone artefact. These finds are summarised in Table 2. As at other inland Kimberley sites (Balme and O'Connor in press), marine shell is present throughout the Holocene both as ornaments and unmodified fragments. Two scaphopod shell beads (Figure 4) were directly dated to ~8,000 cal.

Table 1. Calibrated radiocarbon dates from Square 2.

S#	Lab. Code	XU	Quad	Depth (m)	SU	Sampling context	Material	Curve	d13C	PMC	Radiocarbon age	C14 Age 2 υ
1	D-AMS 001666	1	A	0.0210	1	Sieve residue	Charcoal	SHcal13	−23.9	96.65	273 ± 23	323–151
2	D-AMS 001667	5	B	0.106	2	In situ	Charcoal	SHcal13	−22.1	90.22	827 ± 25	736–671
3	D-AMS 001668	10	D	0.196	3	In situ	Charcoal	SHcal13	−29.2	85.61	1,228 ± 24	1,180–992
4	D-AMS 001669	15	D	0.301	4	In situ	Charcoal	SHcal13	−26	87.56	1,364 ± 29	1,296–1,185
5	ANU-33034	16	A	0.332	5 top	Sieve residue	Scaphopod	Marine13			8,105 ± 45	8,709–8,431
6	ANU-33035	18	C	0.391	5 top	In situ	Scaphopod	Marine13			8,100 ± 45	8,698–8,426
7	D-AMS 001670	18	D	0.371	Burrow	In situ	Charcoal	SHcal13	−31	87.32	1,067 ± 25	966–820
8	D-AMS 001671	18	D	0.385	Burrow	Sieve residue	Charcoal	SHcal13	−18.8	87.32	1,089 ± 26	1,046–920
9	D-AMS 001672	20	D	0.425	Burrow	Sieve residue	Charcoal	SHcal13	−35.8	83.39	1,459 ± 25	1,359–1,285
10	D-AMS 001673	25	D	0.541	Burrow	In situ	Charcoal	SHcal13	−32.4	88.2	1,009 ± 31	930–797
11	D-AMS 001674	25	D	0.536	5	In situ	Charcoal	SHcal13	−22.7	37.07	7,972 ± 30	8,980–8,631
12	D-AMS 001676	29	B	0.666	5	Sieve residue	Charcoal	SHcal13	−25	36.48	8,101 ± 62	9,134–8,649
13	D-AMS 001675	29	B	0.656	5	In situ	Charcoal	SHcal13	−29.8	33.95	8,678 ± 38	9,690–9,531
14	D-AMS 001677	35	D	0.816	5 bottom	In situ	Charcoal	SHcal13	−27.5	33.41	8,807 ± 50	10,120–9,553
15	D-AMS 001678	35	D	0.822	6 top	Sieve residue	Charcoal	SHcal13	−27.2	32.29	9,081 ± 45	10,285–9,943
16	D-AMS 001679	41	B	0.946	6 bottom	In situ	Charcoal	SHcal13	−21.1	31.86	9,188 ± 50	10,489–10,219
17	D-AMS 001680	45	D	1.041	7	In situ	Charcoal	SHcal13	−21.2	30.61	9,510 ± 34	11,065–10,578
18	D-AMS 001681	46	C	1.078	Transition 8/7	In situ	Charcoal	SHcal13	−17.5	25.16	11,085 ± 51	13,051–12,759

Charcoal samples were calibrated using OxCal v. 4.2 (Bronk Ramsey 2009), with the Southern Hemisphere Atmospheric curve [SHcal2013] (Hogg et al. 2013). Marine samples were calibrated using the 2013 marine curve (Reimer et al. 2013).

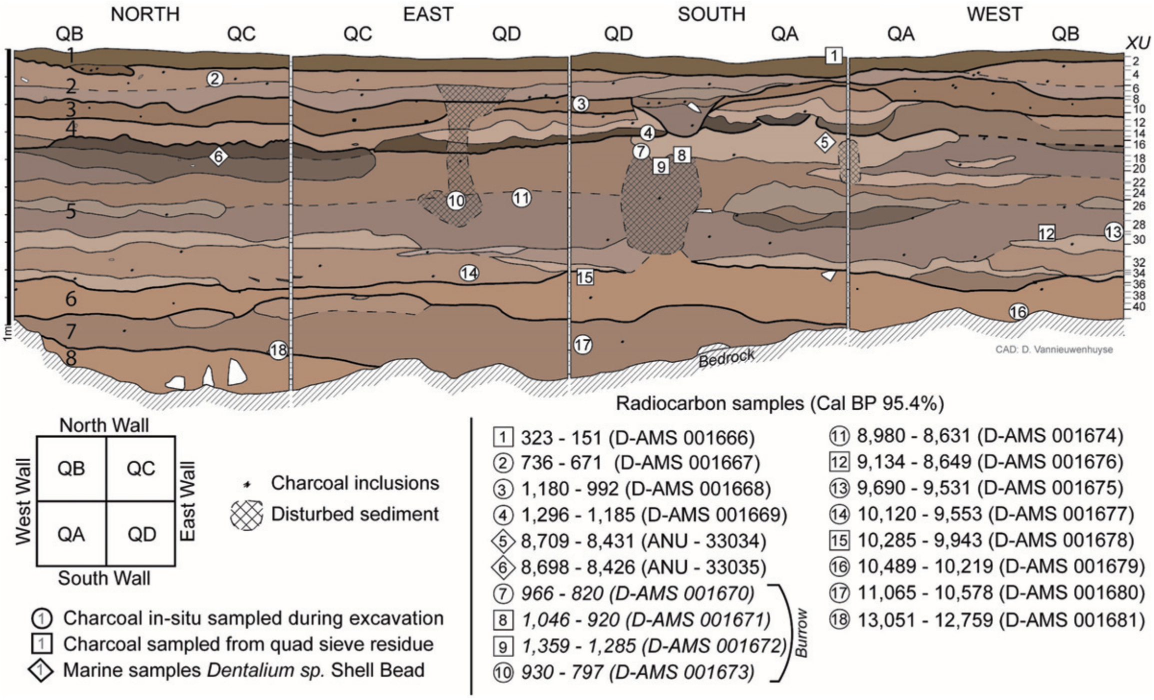

Figure 3. Stratigraphic drawing of square two (Dorcas Vannieuwenhuyse).

BP (ANU-33034, ANU-33035). Other recovered marine shells include eight fragments of *Melo* sp. (baler shell) dated by association to the early Holocene. A single fragment of *Geloina* sp. was recovered from XU 21, also within the early Holocene occupation phase. While these marine shell fragments may have been parts of tools, perhaps similar to others reported from North Western Australia (O'Connor 1999:81, Figure 5.19; Przywolnik 2003:19), they have no traces of use. Fresh water mussel shell (*Lortiella froggatti*) was found throughout Square 2. Most of it is burnt and highly fragmented. This species also occurs in the nearby sites of Carpenter's Gap 1 and 3, throughout the Pleistocene and Holocene (O'Connor 1995; O'Connor et al. 2014:18) and was collected from the Lennard River at the gorge, approximately 200 m to the west. Figure 5(A) illustrates the distribution of fresh water mussel shell, by weight, throughout the sequence. Fresh water mussel is most prevalent in the late Holocene occupation phase, particularly in the uppermost excavation units. This distribution may, in part, reflect the effect of poorer preservation with depth; however, a few peaks in the distribution of shell that appear to correlate with the distribution of charcoal (Figure 5D), suggest that preservation is not the only factor at play. The recovered bone has not been identified to species, although long bones and teeth of rodents and small reptile vertebrae are abundant, and the species composition appears superficially similar to that reported in 2008. In contrast to the shellfish and charcoal, the greatest discard peak in bone occurs in the early Holocene occupational phase, with a marked decline in the late Holocene.

Table 2. Summary of recovered materials from Square 2.

XU	Total vol. (L)	XU depth below surface (m)	TNA #	MNF #	Charcoal (g)	Bone (g)	Painted limestone #	Pigment (g)	*Lortiella froggatti* (g)	Avian Shell (g)	*Melo* sp. (g)	Scaphopod (g)	*Geloina* sp. (g)	Seeds (g)
1	32	0.021	33	23	0.10	13.28			8.65					
2	30	0.050	47	24	7.02	8.43	1		9.64					2.20
3	27	0.071	53	31	14.88	4.41			12.52					1.29
4	30	0.094	43	22	1.29	2.21		3.87	20.68	0.29				0.33
5	22	0.114	35	16	8.93	5.60			12.52	0.47				0.10
6	25	0.135	33	18	3.04	3.86			7.40	0.31				0.13
7	20	0.153	16	7	2.24	2.78			21.83	0.74				0.14
8	23	0.170	16	9	0.73	3.23			2.64					0.17
9	20	0.188	6	4	2.06	1.97			1.13	0.04				0.51
10	27	0.210	15	11		3.43			0.95					0.16
11	29	0.236	37	22	0.18	7.88			0.35	0.15				0.25
12	26	0.254	20	9	0.65	4.48			0.32					
13	26	0.276	12	6	0.02	11.50			1.22	0.02				
14	26	0.291	22	13	3.06	17.53		10.53	6.29	0.17				
15	29	0.312	17	11	0.69	15.16			4.96		0.60			
16	29	0.332	12	6	1.29	7.50		7.6	3.08	0.06	0.40	0.30		
17	32	0.358	21	14	4.53	7.10		1.5	4.76		0.49			
18	31	0.385	19	9		5.25		0.8	6.36			0.18		0.28
19	25	0.397	14	8	1.87	7.92	2	109.18	2.62		0.12			
20	27	0.425	8	6	0.00	12.75			0.56					0.05
21	31	0.451	15	12	3.77	37.34	2	3.29	3.28				2.41	
22	22	0.471	9	8	0.79	4.37			0.87	0.26				
23	29	0.493	18	8	0.24	8.42			3.21					
24	28	0.517	15	11	3.74	8.85			1.09					0.11
25	30	0.541	16	10	1.12	12.80		5.26	1.28					
26	40	0.583	4	4	8.50	12.73			2.33					
27	37	0.613	21	11	2.10	21.23			3.80					
28	31	0.647	14	10	2.80	9.94			1.15					
29	31	0.666	3	2	2.37	7.22			0.68		0.52			
30	34	0.688	8	2		10.33			0.23		1.91			
31	38	0.730	10	9	3.87	10.12			2.34		1.50			
32	27	0.752	15	9	2.26	7.45			2.48					
33	31	0.776	13	7		13.92		2.5	4.00					
34	27	0.793	13	9		11.73		0.7	3.45		0.35			0.27
35	25	0.822	8	6		28.45			0.19					
36	34	0.840	13	6	0.49	10.89			2.30					
37	32	0.865	13	8	1.07	38.05			0.67					
38	22	0.887	39	18		29.44			0.13					0.13
39	24	0.912	67	35	0.19	24.29			0.70					1.38
40	27	0.933	41	24		39.28			0.24					0.08
41	24	0.959	40	20	2.50	15.10			0.42	0.05				0.21
42	31	0.978	18	7	0.50	19.77			0.16	0.08				1.29
43	27	1.008	9	7	5.80	15.19			0.36					0.18
44	17	1.026	3	1	0.52	3.75			0.53					
45	20	1.053	5	4	1.92	1.26			0.09					
46	3	1.083	1	1		1.39								
47	21	1.105				0.19								0.18
48	17	1.115												
49	8	1.161			0.10									
50	3	1.176			7.02									2.20
51	5	1.196			14.88									1.29
52	7	1.201			1.29									0.33

This contrast may suggest a non-anthropogenic origin for the bone, especially as the discard rate for stone artefacts (Figure 6) appears to follow more closely that of charcoal and shellfish.

The apparent absence of aquatic foods other than freshwater shellfish in the diet is puzzling given the site's proximity to Windjana Gorge (∼200 m). O'Connor et al. (2008:78) noted the lack of fish bones in the 1994 excavation, suggesting that it may have passed through their sieves, the smallest of which had a 3 mm mesh. However, the 2012 excavation used a 1.5 mm sieve. Aquatic resources such as freshwater crocodiles, barramundi, black bream, eels, freshwater crustaceans and water birds are abundant in the gorge. The presence of mussel shell throughout indicates that the gorge contained standing freshwater and thus the lack of other aquatic fauna seems curious.

A bone point tip fragment with striae dates to the late Holocene (XU5) (736 to 671 cal. BP, D-AMS 001667).

A total of 936 stone artefacts were recovered from Square 2 of which the dominant raw material is crystal quartz (59%). Water rolled cobbles of crystal quartz are found within the Lennard River gravel beds, and formed crystals occasionally occur in conglomerate bands in the limestone. White vein quartz is locally abundant, but was not as frequently exploited (4.2%) as crystal quartz. Other raw materials include fine-grained quartzite (12.5%) and chert (12.3%), with basalt, tuff, sandstone and chalcedony also present (12%).

The lowest observed stone artefacts are from XU 46 (13,051 to 12,759 cal. BP D-AMS 001681) which marks the beginning of a stone artefact discard peak which ends in XU 35 (Figure 6) dated by two overlapping radiocarbon dates of 10,120 to 9,553 cal. BP (D-AMS 001677) and 10,285 to 9,943 cal. BP (D-AMS 001678). For the rest of the early Holocene phase stone artefact discard is lower. The late Holocene occupation deposit reveals an increase in artefact discard peaking around XU 5, dating to 736-671 cal. BP (D-AMS 001667). A single pressure flaked bifacial point is associated with two overlapping dates of 968 to 822 cal. BP (D-AMS 001670) and 1,049 to 916 cal. BP (D-AMS 001671) (see Maloney et al. 2014:139, Figure 2). Two other unifacial points were recovered in the late Holocene units.

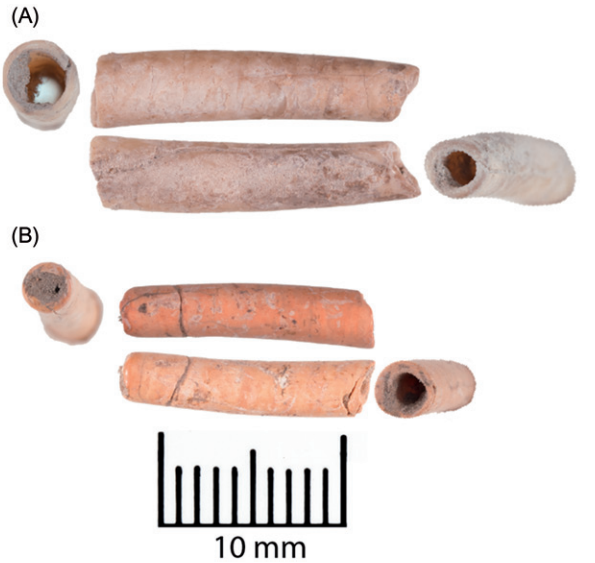

Figure 4. Scaphopod beads. (A) Bead from EU 16; (B) bead from EU 18.

The shelter wall has an assemblage of painted art in red, orange and white pigments. The motifs are mostly snakes ($n = 18$) and eels ($n = 4$), identified by the presence of fins behind the head. Ochre pieces and limestone fragments with traces of pigment were found in both occupation phases (Table 2).

Conclusion

The excavation in *Djuru* was extended to bedrock, establishing that the site was used from at least the terminal Pleistocene 13,000 years ago. Differences in the chronostratigraphic sequence across the site were identified. The Square 2 deposit contained two dated phases of occupation representing the terminal Pleistocene to early Holocene and the late Holocene. The period of 7,000 to 1,300 cal. BP identified in Square 1 (O'Connor et al. 2008), is absent in the

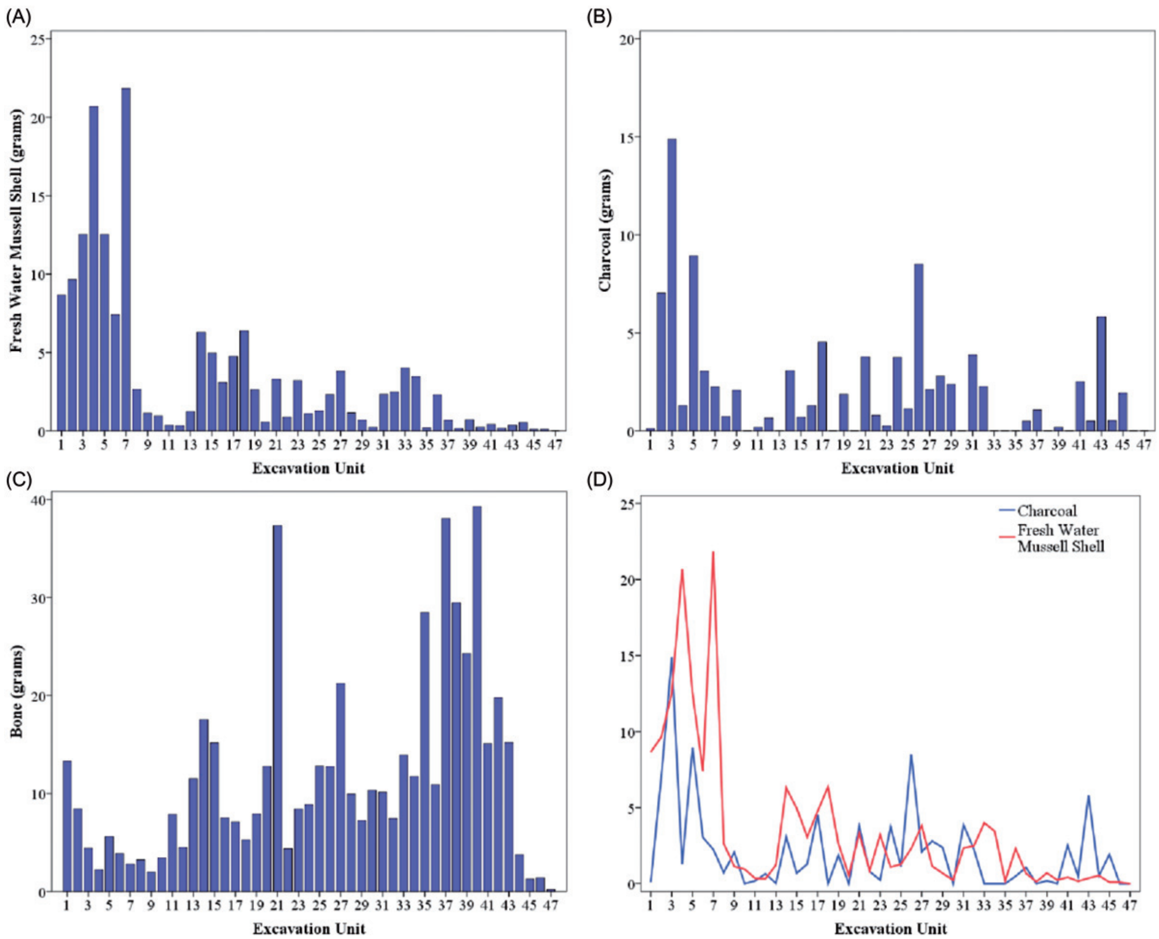

Figure 5. Discard trends relative to excavation units showing weight (g) combined for both 3 and 1.5 mm sieve fractions. (A) Fresh water mussel shell; (B) charcoal; (C) faunal remains; (D) correlation of fresh water mussel shell and charcoal.

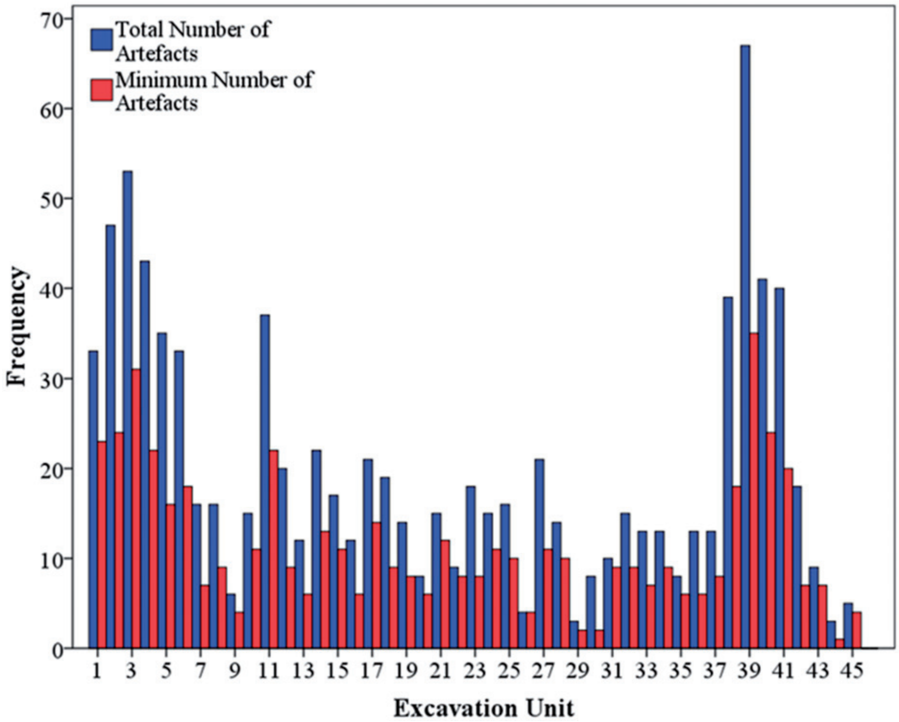

Figure 6. The total number of stone artefacts (936) and the minimum number of flakes (517) (after Hiscock 2002:254) for each excavation unit.

part of the site sampled by Square 2. This small shelter, approximately 10 × 3 m, illustrates how stratigraphy and cultural materials within a site can vary dramatically over small spatial distances, emphasising the need for sampling across the floor of deposits if larger excavations are not possible, and caution in using the chronological sequences in small excavation squares to model regional occupation patterning.

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Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article

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