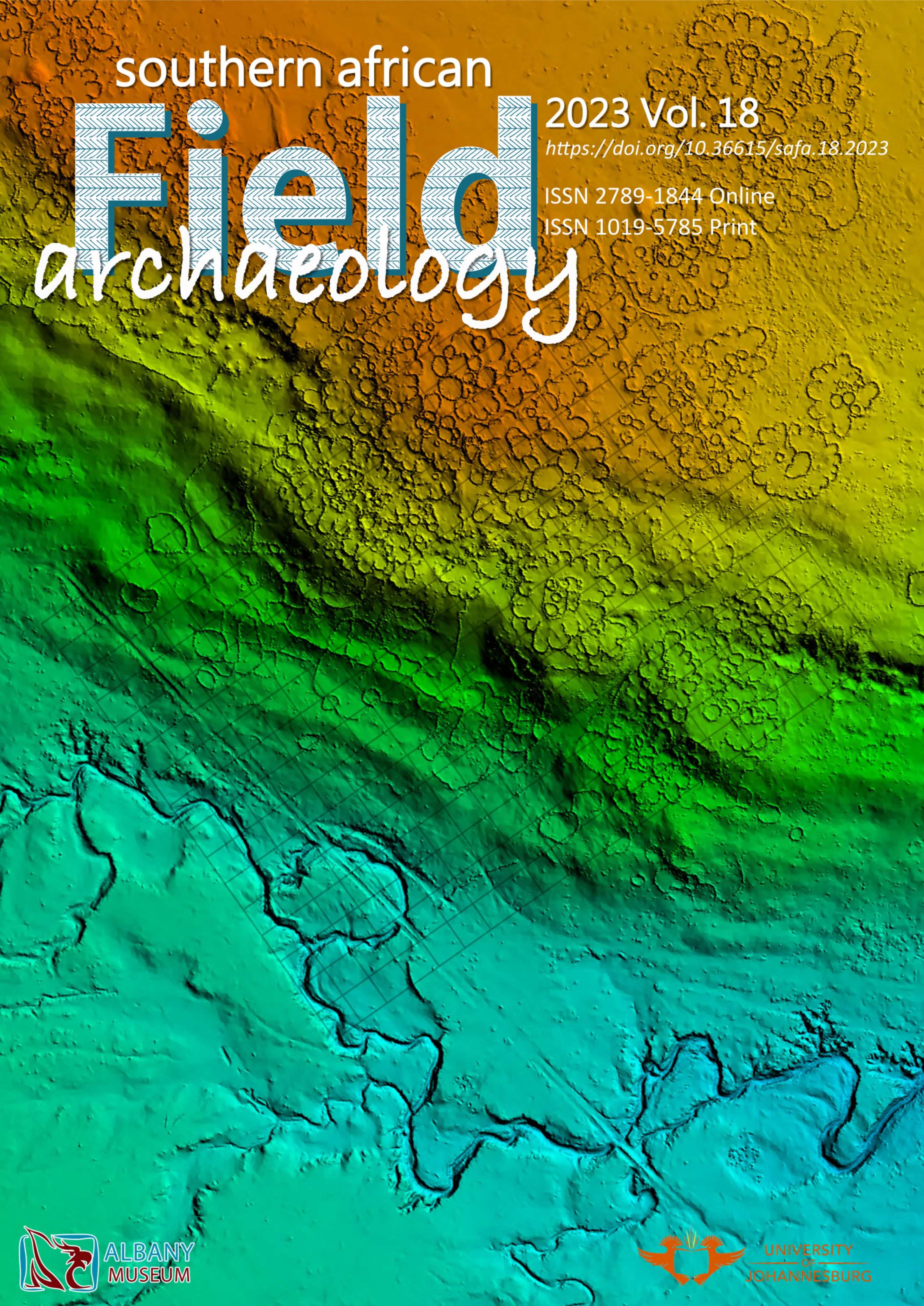

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Diving into the collections: Analysing two excavated Sotho-Tswana compounds in the Suikerbosrand, Gauteng Province

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ABSTRACT
In this article, we set out to publish the results of extensive excavations conducted in the late 1980s and early 1990s by staff and students of the Archaeology Department, University of the Witwatersrand, at two Late Iron Age stone-walled compounds in the western foothills of the Suikerbosrand massif, near Johannesburg. While these two compounds, Sun Shadow and Boschoek, have been extensively cited in the literature, their data have never been published. Here, we analyse the distribution of their collected artefacts, in conjunction with their field maps, to better understand the spatial organisation of these two Molokwane-style stone-walled compounds. We were also interested to assess the merits of revisiting under-analysed archaeological materials housed in the University of the Witwatersrand's collections. The results revealed frustrating gaps and shortcomings in the collections, but also shed new light on the social organisation of these settlements. Overall, we feel that the exercise was worthwhile and we encourage similar such studies in the future, allowing researchers to explore the scientific potential of the masses of buried treasure within the university's collections.

Keywords: Late Iron Age, stone-walled structures, Batswana settlement organisation, spatial analysis, ethnographic analogy

1. Introduction

Bantu-speaking farming and herding communities first colonised the Highveld grasslands around AD 1600, and in a short time left behind thousands of stone-walled ruins (Huffman 2007; Sadr 2020). In the past 30 years, research has focused on linking these stone-walled ruins to ethnographically known cultural groups, and explaining their social, political and economic organisation, as well as their regional interactions (e.g., Maggs 1976a, b; Taylor 1979; Loubser 1985; Huffman 1986, 2007; Mason 1986; Lane 1998; Pistorius 1992, 1994, 1996, 1997; Hall 1998; Boeyens 2000, 2003; Huffman et al. 2007; Fredriksen 2007; Anderson 2009; Boeyens & Hall 2009). Here, we focus on two stone-walled compounds in the western foothills of the Suikerbosrand massif, which were designated as Sun Shadow and Boschoek by their excavators (Taylor 1984; Huffman 1986; Hodgson 2019, 2021).

In 1984, a brief report and a map of Sun Shadow was published by Mike Taylor. Two years later, in 1986, the area of the largest lobe or scallop in the perimeter wall of Sun Shadow was excavated by three University of the Witwatersrand (Wits) archaeology honours students, namely Kaplan (1986), Sales (1986), and de Wet (1987). In the same year, Tom Huffman published the first map of the neighbouring Boschoek compound, calling it the east unit at Boschoek (Huffman 1986, 1988). Sun Shadow and Boschoek were both excavated again over five seasons by Wits archaeology undergraduates, between 1991 and 1994. Boschoek was excavated more extensively than Sun Shadow, but few details of the excavations, or the finds from either compound, were published.

Sun Shadow and Boschoek are part of a cluster of stone-walled ruins – a neighbourhood – situated around a rocky ridge approximately 300 m west of the Suikerbosrand Nature Reserve boundary fence (Fig. 1), at the southern edge of the farm Blesboklaagte 181 IR. Today, the two compounds are covered in *Vachellia tortilis* trees, which hide many of the stone walls. Architecturally, both compounds were built in the Molokwane style, and their ceramics are of the Buispoort facies (Huffman 2007). It is widely agreed that Batswana constructed stone-walled compounds in the Molokwane style and Huffman (2007) specifically attributes this architectural style to the precolonial Bakwena and Bahurutshe polities.

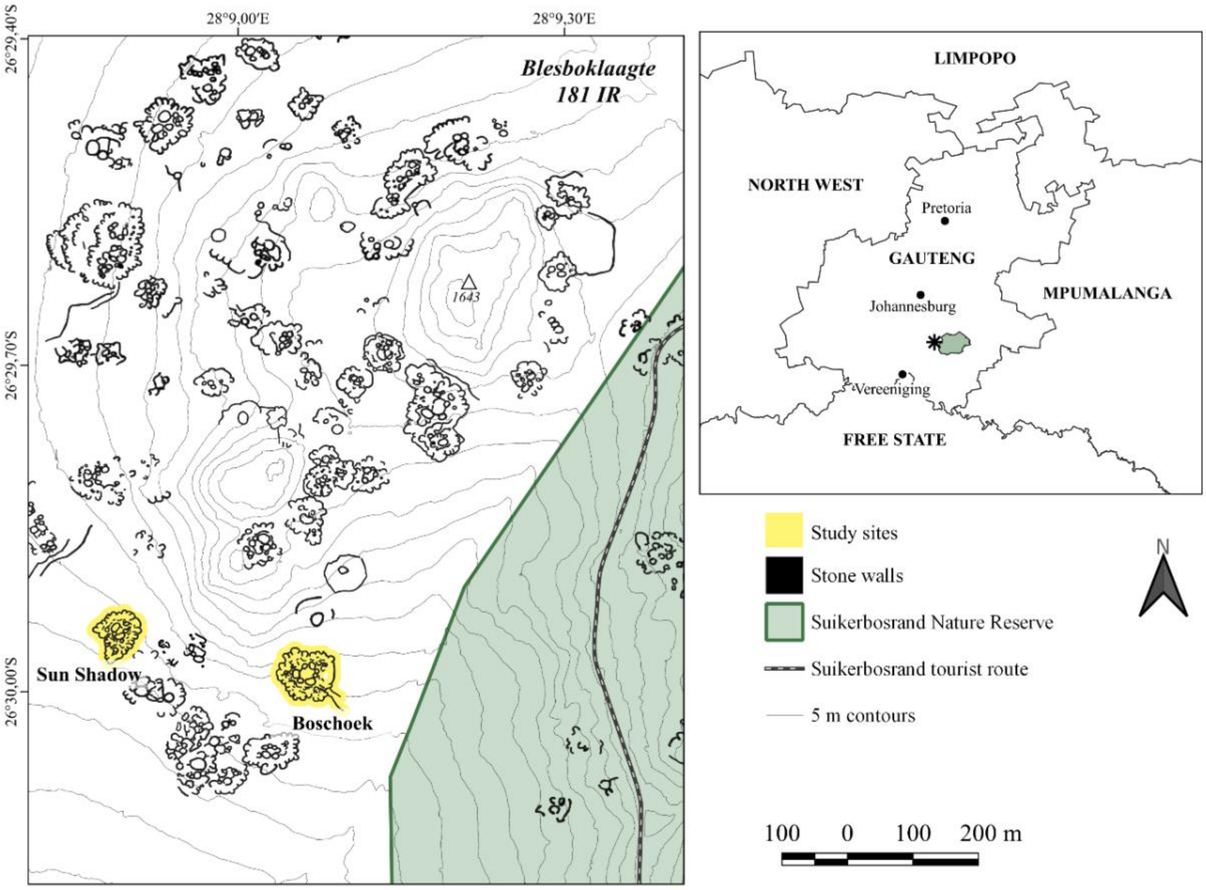

Figure 1. The locations of Sun Shadow and Boschoek (yellow highlight) in relation to the other compounds in the neighbourhood, and to the Suikerbosrand Nature Reserve (green) in the Gauteng Province, South Africa.

Both compounds have a scalloped perimeter wall, with a few openings into the residential zone which surrounded the central livestock pens (Fig. 2). Each scallop in the perimeter seems to have formed the back-courtyard wall of a cone-on-cylinder, mud-walled and thatch-roofed house. In the front courtyards, there are various stone-walled features, including windbreaks for cooking areas, various low stone alignments which served as partitions and demarcations for routes, and at Sun Shadow some corbelled stone huts occur that may have served as shelters for herd boys (Huffman 2007). The corbelled stone huts are characteristic of the Type V style of architecture found predominantly to the east and south of the Suikerbosrand area. Their presence at Kweneng, a major Sotho-Tswana settlement that was destroyed two hundred years ago during the *Difeqane* civil wars (Sadr 2019), within Molokwane-style compounds fortifies the conclusion that this site was a multi-cultural settlement (Sadr 2022). In the central zone of each compound, there are a collection of linked stone-walled circles that served as pens for large and small livestock. There are several stone towers built into the outer walls of these pens, which may have served as elevated platforms for grain storage structures (Taylor 1984; Huffman 1986; Sadr 2022).

Sun Shadow and Boschoek fall within the footprint of Kweneng. It appears that the occupants left their belongings and hastily abandoned the settlement, never to return. The distribution of objects at these two excavated compounds, therefore, provides us with a snapshot of the daily activity at a Late Iron Age settlement on the Highveld. Although it is only one snapshot – and many consecutive snapshots over a longer period would be required to do justice to the topic – we ask what can the distributions of all these objects tell us about the social organisation of space within these compounds? A spatial analysis of the stone-walled features at two unexcavated compounds in Kweneng – Fern's compound and the Pitted compound (Sadr & Mshuqwana 2020; Sadr 2021) – recently provided useful information on this topic, but at Boschoek and Sun Shadow, we have the added benefit of a wealth of excavated artefacts and features to provide more context and resolution.

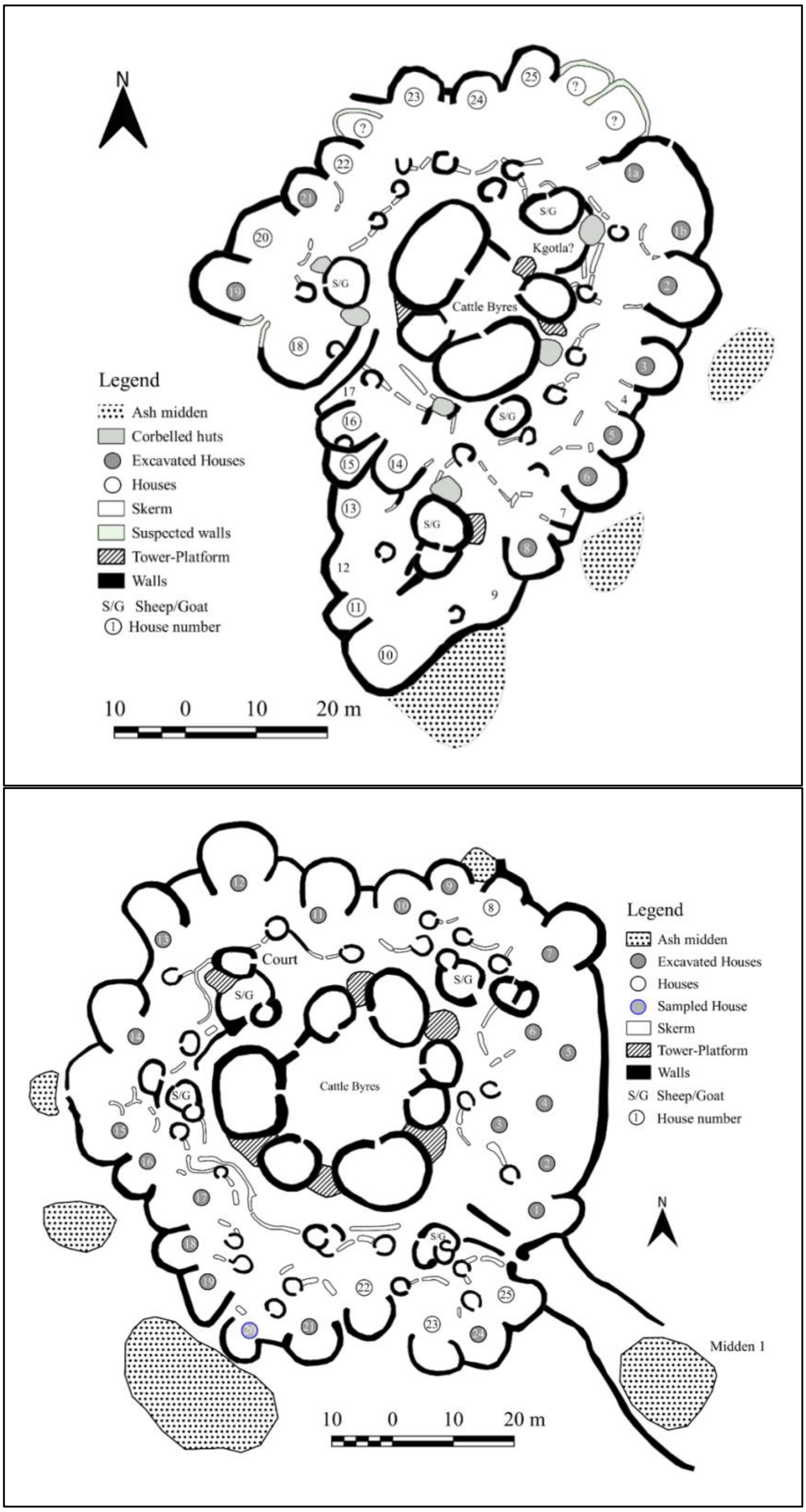

Figure 2. Sun Shadow (top map) showing the excavated houses (adapted from Taylor 1984 and Kaplan 1986); Boschoek (bottom map) showing the excavated houses (adapted from Huffman 1986, 2007).

The rationale for this project is to improve our understanding of the social organisation of space in the Late Iron Age compounds of Kweneng, and to see how these might correspond with the more recent ethnographically-known spatial organisation of Batswana wards. Furthermore, we wanted to assess the feasibility of examining under-analysed archaeological collections stored at Wits, and by doing so, to heed the (largely ignored) call to arms published long ago by Jannie Loubser (1990) and Aron Mazel (1991); who pointed out that it is the responsibility of archaeologists to make our findings available not only for outside scrutiny within the scientific community but also to the wider South African public, who have a vested interest in, and the right to view, work undertaken in their communities. Our exercise was partially successful, and we begin with a short description of the methods and materials used in our study.

2. Methods and materials

The materials used in this study comprise the artefacts excavated from both Sun Shadow (2628CA1/a) and Boschoek (2628CA1/c) (Fig. 2); several methods were employed in this project. First, all the excavation logs and maps relating to Sun Shadow and Boschoek were digitised for GIS mapping. QGIS (QGIS Development Team 2020) was used to create maps for each excavated house in the two compounds. Kaplan's (1986) map of Sun Shadow and Huffman's (2007) map of Boschoek were geo-referenced, as were available field maps of house excavations. Thereafter, all the artefacts from the two sites were recorded and classified. Photographs were taken of all metal objects and pottery, as well as any other unusual items. Information on the distribution of the artefacts was stored in Microsoft Excel spreadsheets and GIS data sets. Finally, the spatial distribution of artefacts was analysed.

The main limitation of this study was the bias towards house excavations and the inconsistent quality of excavation maps and field notes. From Boschoek, a few of the house excavation maps were missing, as were excavation notes for houses B3, B6, B7, B12, and B18. About half of the Boschoek excavation maps had no north arrows or other positioning information. The records from Sun Shadow were considerably more complete. None of the field notes mentioned a sieving process and, in the photographs taken at the time, there are no signs of any sieves. We assume therefore that some tiny artefacts were not collected. Furthermore, there were discrepancies in the amount of artefacts recorded in the field notes versus the actual quantities that were recorded during this research, particularly in the amount of potsherds, but there is no detailed information about the sampling strategy that determined which artefacts were kept and which were left behind. We will describe these gaps in more detail at the appropriate juncture. Finally, because of a lack of cooperation from the present landowner, it was not possible for us to revisit these sites. Thus, unusual differences between the maps of the two compounds, such as the presence of corbelled stone-huts at Sun Shadow and their absence at Boschoek, could not be confirmed.

3. Results

In total, just over 15 000 objects were recovered from both Sun Shadow and Boschoek (Table 1). About a third of these came from Sun Shadow. The remainder comes from Boschoek: a third from the excavation of the ash midden and the rest from the house excavations. On average, each house excavation at Sun Shadow produced about twice as many finds as the average house at Boschoek. This probably indicates that not all the excavated finds from Boschoek were collected. In addition, we did not count all the bone and charcoal in the Boschoek collection due to time constraints and the discovery of human remains in the midden material.

If we begin with the null hypothesis that each house in each compound should contain about the same amount and diversity of material remains, several interesting anomalies immediately become evident. For example, even though only about a third of the houses at Sun Shadow were excavated, these show an uneven distribution of finds with the house area of S1 containing nearly half of all the excavated finds from this compound. It should be noted that this area contained two mud-walled and thatch-roofed structures, and a considerable amount of material also came from the intervening space between these structures (Fig. 3). House S6 at Sun Shadow also contains an unusually large number of objects in comparison with the remaining excavated houses (Fig. 4a), although the excavated area here is rather small. At Sun Shadow, the houses with the largest number of excavated objects are on the right-hand side of the compound; a pattern that is also repeated at Boschoek (Fig. 4b). Following the Central Cattle Pattern (CCP) principles for organising space in traditional settlements of southern Africa (Huffman 1986, 2001), the right-hand side of the compound should house the more senior members. The greater number of objects coming from the right-hand side of the two excavated compounds may reflect this seniority, but we cannot be certain because at Sun Shadow a few houses in the left-hand side were excavated, and in Boschoek an unknown quantity of material from some or all the house excavations was left behind in the field.

Table 1. All finds recovered from Sun Shadow (S) and Boschoek (B).

House	Fauna	Stone	Metal	Ceramic	Beads	Building material	Sum
S1	15	124	1	1806	2	418	**2366**
S2	48	5	1	460	-	1	**515**
S3	1	1	2	119	-	-	**123**
S5	7	11	-	345	-	10	**373**
S6	196	12	90	458	366	150	**1272**
S8	3	4	1	41	-	191	**240**
S19	29	22	9	115	-	-	**175**
S21	5	12	1	466	-	-	**484**
B1	22	8	4	534	-	-	**568**
B2	20	7	-	309	-	-	**336**
B3	67	2	-	185	-	1	**255**
B4	27	7	4	584	-	-	**622**
B5	5	8	2	257	-	-	**272**
B6	-	-	-	225	-	-	**225**
B7	63	-	3	1005	-	-	**1071**
B9	1	-	-	-	-	-	**1**
B10	1	8	-	262	-	-	**271**
B11	-	-	-	1	-	2	**3**
B12	-	-	-	69	-	2	**71**
B13	38	-	1	41	-	19	**99**
B14	24	1	-	96	-	-	**121**
B15	163	1	4	196	-	16	**380**
B16	67	6	1	486	-	1	**561**
B17	-	5	1	45	-	3	**54**
B18	312	9	1	87	-	-	**409**
B19	4	-	-	106	-	-	**110**
B20	-	-	-	-	-	-	**0**
B21	41	7	-	187	-	-	**235**
B24	109	17	1	198	-	3	**328**
BM1	47	1405	9	2051	10	6	**3528**
Sum	**1315**	**1682**	**136**	**10734**	**378**	**823**	**15068**

Nevertheless, at first glance, the distribution of objects seems to support the idea that in these two compounds, social seniority is reflected in the quantity of artefacts. A closer look at the more complete sample from Boschoek, however, reveals some important caveats. Although houses B1-B12 on the right-hand side of Boschoek contain about 3/5th of the excavated objects (not counting the midden excavation), the bulk of this material comes from houses B1-B7; indeed, the row of houses B9-B14 at the top-end of Boschoek, i.e., the highest status zone according to the CCP principle, curiously contain relatively few excavated objects (Fig. 4b). The distribution of artefacts thus hints at a more complex situation than merely a reflection of status.

A major issue that distorts our understanding of the spatial organisation at these two compounds is the bias towards house excavations. The artefact distributions at Boschoek and Sun Shadow reflect a frozen moment in time when the Matabele attacked and Kweneng was burnt down and abandoned forever (Sadr 2019). Considering the amount of material found outside the houses in area S1 of Sun Shadow, it appears the occupants were surprised by the impending attack during daylight hours when activities were taking place outdoors. This is based on the assumption that the front courtyard would be cleaned in the evening and the pots, food remains, and stone tools would not be left out overnight. If that is the case, we must assume that the objects excavated from inside each house do not represent a complete catalogue of the belongings of that house's occupants. If such activity was taking place in the courtyards at the hour of abandonment, then we are missing a large part of the evidence for reconstructing the social organisation of space at these two compounds. Future excavations in the open areas around the houses may provide a more complete view of the material wealth of each house. For now, all we can do is keep this caveat in mind when interpreting the data. Below, we describe and analyse the distribution of the different classes of finds excavated from these two compounds.

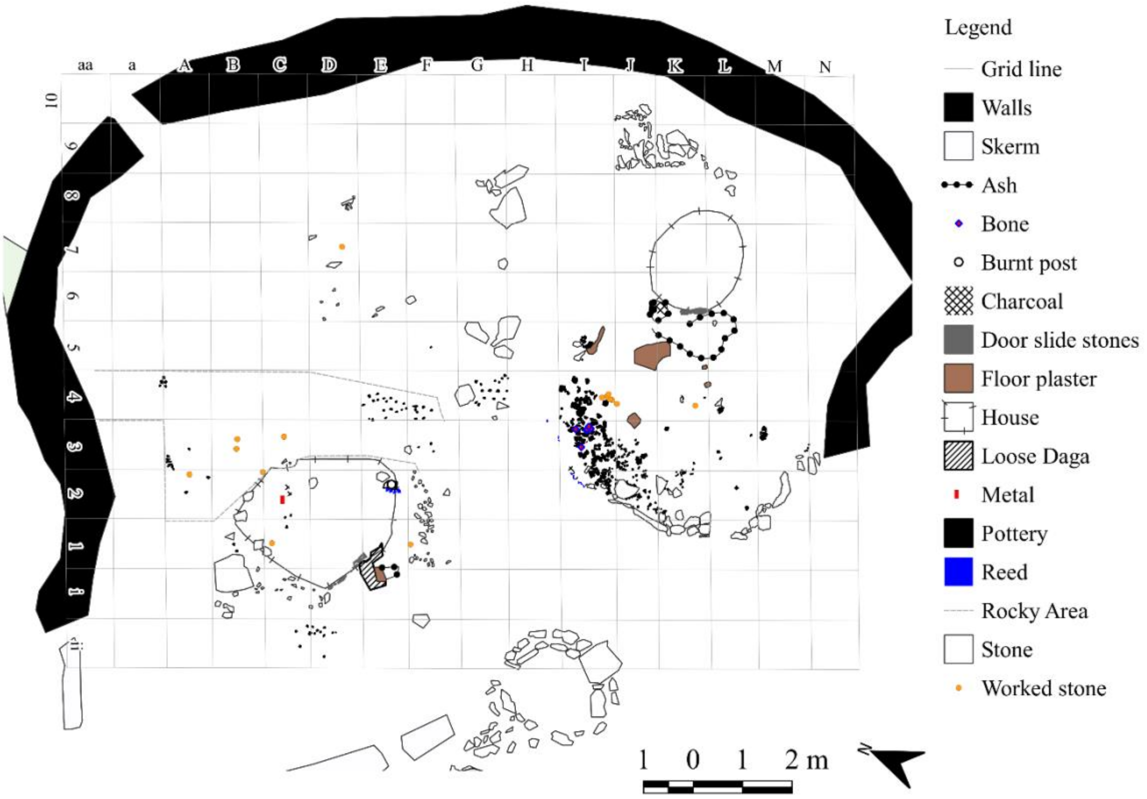

Figure 3. The excavation map of house area S1 at Sun Shadow (after Kaplan 1986, Sales 1986 and de Wet 1987).

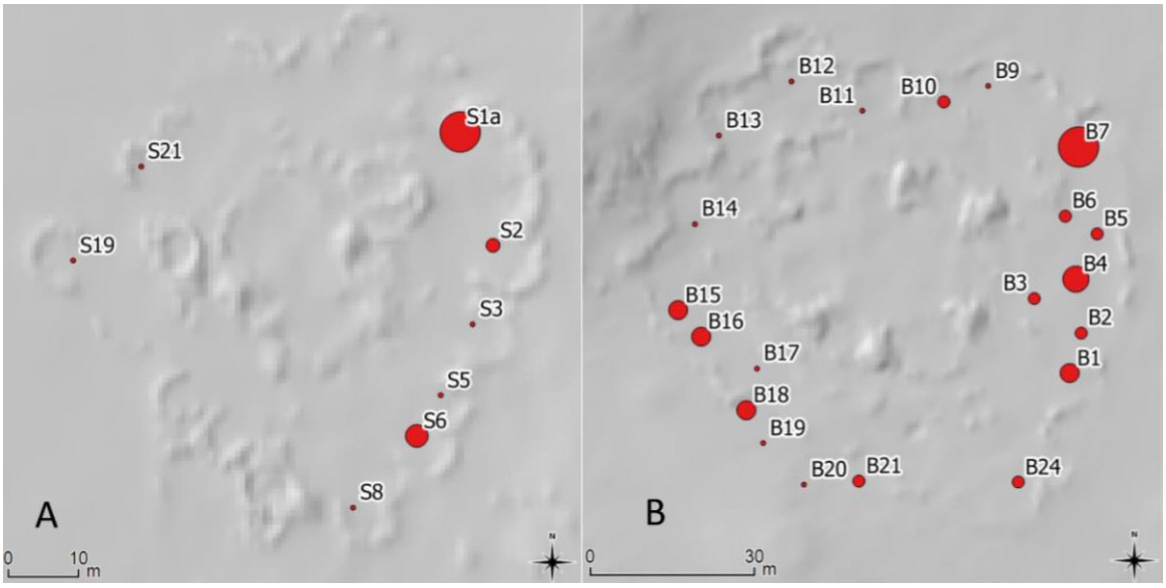

Figure 4. The distribution of all finds at Sun Shadow (a) and Boschoek (b). The size of the circle indicates the number of objects from each house excavation; see Table 1 for details.

Beads

There is a stark bias in the distribution of beads within and between these two compounds. At Sun Shadow only three of the eight excavated house areas contained beads. House S1, which is otherwise the richest in number of finds, contained only two ceramic beads, and house S2 contained a single ostrich eggshell bead. Surprisingly, house S6 revealed a mass of ceramic beads (n=294), copper beads (n=72) and ostrich eggshell beads (n=47). These were found tightly clustered together with other metal ornaments, and perhaps were originally all together in a bag, perhaps cached in the rafters. At Boschoek, ostrich eggshell fragments were found in four of the houses, but none are bead preforms. The excavation of the midden at Boschoek produced 10 ostrich eggshell beads.

Metal

We alluded to other metal ornaments in the cache from house S6 at Sun Shadow, and indeed this is the house that yielded most of the metal items from these two compounds (Table 2). Two copper earrings and a bundle of copper wire were part of the hoard, as well as several other metal artefacts, notably seven iron ingots as well as some tools and spearheads (Fig. 5a). It is noteworthy that following CCP guidelines, house S6 is not located in an area that might indicate a high-status occupant. One of the reviewers of this paper suggested that the presence of this hoard hints at economic independence, possible specialisation, and perhaps that it reflects a tension between CCP guidelines and self-realisation – the distance between rules and daily practice. In that case, this hoard has nothing to do with status, but speaks to the skill sets, regional social networks, and kin connections of the occupants of house S6, who may have obtained the copper wire, iron ingots and spear tangs for recycling and exchange. Of the other excavated houses at Sun Shadow, five have only one or two metal artefacts each, and most of these are spearheads. Two of the houses contained no metal: one on the left- and the other on the right-hand side of the compound (Fig. 6). In Sun Shadow house S8, there was a metal object with two holes punched through the middle (Fig. 5b).

Table 2. Metal objects recovered from Sun Shadow (S) and Boschoek (B).

House	**Iron ingots/tangs/pins/rods**	**Axe/adze**	**Spearhead/point**	**Unidentified metal object**	**Iron slivers/flakes**	**Copper earring**	**Copper wire**	**Copper beads**	**Razor**	**Hoe**	**Modern pressed metal**	**Other**	**Sum**
S1	-	-	-	-	1	-	-	-	-	-	-	-	**1**
S2	-	-	1	-	-	-	-	-	-	-	-	-	**1**
S3	-	-	2	-	-	-	-	-	-	-	-	-	**2**
S6	7	1	3	2	-	2	1	72	2	-	-	-	**90**
S8	-	-	-	-	-	-	-	-	-	-	-	1	**1**
S21	-	-	1	-	-	-	-	-	-	-	-	-	**1**
B1	2	-	2	-	-	-	-	-	-	-	-	-	**4**
B4	-	-	-	-	3	-	-	-	-	1	-	-	**4**
B5	-	-	2	-	-	-	-	-	-	-	-	-	**2**
B7	1	-	1	-	-	1	-	-	-	-	-	-	**3**
B13	-	1	-	-	-	-	-	-	-	-	-	-	**1**
B15	-	-	4	-	-	-	-	-	-	-	-	-	**4**
B16	-	1	-	-	-	-	-	-	-	-	-	-	**1**
B17	-	-	1	-	-	-	-	-	-	-	-	-	**1**
B18	-	-	-	1	-	-	-	-	-	-	-	-	**1**
B24	1	-	-	-	-	-	-	-	-	-	-	-	**1**
BM1	2	-	1	5	-	-	-	-	-	-	1	-	**9**
Sum	**13**	**3**	**18**	**8**	**4**	**3**	**1**	**72**	**2**	**1**	**1**	**1**	**127**

In Boschoek, only about half of the 21 excavated house areas contained metal artefacts, so if the sample is not biased, metals seem to have been more accessible to the inhabitants of Sun Shadow. The Boschoek sample comprises a single copper earring that came from house B7, with spearheads making up just over half of all the metal artefacts in the collection. Most of the other iron artefacts here are ingots and unidentified bits of metal. Only one farming implement, a hoe, was found, although the two axes/adzes could also have been used in agricultural or other maintenance activities. The rarity of hoes in the compounds may mean that such tools were kept in field huts rather than in the main settlement, or that iron was too rare to use for such tools as suggested by Maggs (1976a). Indeed, most agricultural/maintenance tools may have been in use outside the houses when the site was attacked and so would not be encountered in the excavations. An oddity is the relatively high number of spearheads and points found in both compounds: one would imagine the men would have armed themselves in the face of attack and taken the spears out of the houses. Lastly, a piece of modern pressed metal was recovered in the Boschoek midden and hints at the post-abandonment disturbance of its deposits (Fig. 5c).

Figure 5. Metal artefacts from house S6 (a), house S8 (b) and from a Boschoek midden (c).

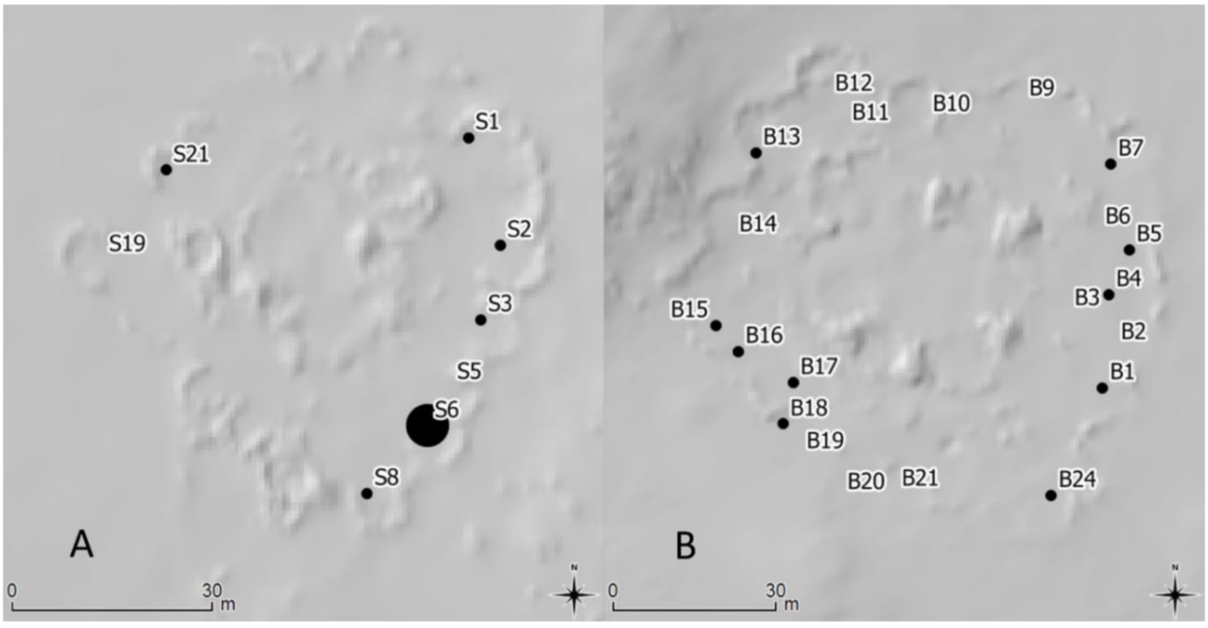

Figure 6. The distribution of all metal finds at Sun Shadow (a) and Boschoek (b). The size of the black circle indicates the number of objects from each house excavation; see Table 2 for details.

Stone

A variety of stone artefacts were excavated at the two compounds, but their distribution is uneven (Table 3). Sun Shadow produced 169 stone artefacts and all the houses contained at least a few; however, over two-thirds of Sun Shadow's collection of stone artefacts came from house area S1, and this house also had the largest diversity in types. Among its finished tools were an adze, two burnishing stones, two grindstones and seven hammers. There were also an unusually large number of flaked stones and manuports (unmodified pieces of stone) in the S1 area. More detailed analyses might show that the stone flakes were used as scrapers in hide working (cf. Mason 1969; Binneman & Van Niekerk 1986). Furthermore, this area produced a stone amulet and a piece of ochre.

The diversity and number of stone artefacts in the other houses at Sun Shadow were more limited. All houses in Sun Shadow contained grinding stones[1], and about half the houses contained a few flaked stones and manuports. Two houses, aside from S1, contained burnishing stones. These numbers suggest that grindstones were part of the standard kit of every house, and a few stone flakes and manuports were not unusual either. The few burnishing stones suggest a special activity (burnishing pots?) that may have been restricted to only a few members of this compound.

Table 3. Stone objects recovered from Sun Shadow (S) and Boschoek (B). Those recorded on excavation maps or post excavation photos, but not included within the collection, are denoted by 'x'.

House	**Adze**	**Burnisher**	**Hammer**	**Grinder**	**Flaked**	**Manuport**	**Ochre**	**Mica/specularite**	**Amulet**	**Crystal**	**Bog iron**	**Ironstone**	**Sum**
S1	1	2	7	2	61	46	1	-	1	-	3	-	**124**
S2	-	-	-	4	-	1	-	-	-	-	-	-	**5**
S3	-	-	-	1	-	-	-	-	-	-	-	-	**1**
S5	-	-	-	6	3	2	-	-	-	-	-	-	**11**
S6	-	-	-	5	-	7	-	-	-	-	-	-	**12**
S8	-	1	-	x	3	-	-	-	-	-	-	-	**4**
S19	-	4	-	4	5	-	-	-	-	-	-	9	**22**
S21	-	-	-	5	2	3	-	1	-	-	-	1	**12**
B1	-	-	-	8	-	-	-	-	-	-	-	-	**8**
B2	-	-	-	x	-	7	-	-	-	-	-	-	**7**
B3	-	-	-	-	-	2	-	-	-	-	-	-	**2**
B4	-	-	-	1	-	6	-	-	-	-	-	-	**7**
B5	-	-	-	5	-	3	-	-	-	-	-	-	**8**
B7	-	-	-	x	-	-	-	-	-	-	-	-	**0**
B10	-	-	-	x	-	8	-	-	-	-	-	-	**8**
B13	-	-	-	x	-	-	-	-	-	-	-	-	**0**
B14	-	-	-	1	-	-	-	-	-	-	-	-	**1**
B15	-	-	-	x	-	1	-	-	-	-	-	-	**1**
B16	-	-	-	2	1	1	-	-	-	2	-	-	**6**
B17	-	-	-	5	-	-	-	-	-	-	-	-	**5**
B18	-	-	-	2	6	-	-	1	-	-	-	-	**9**
B20	-	-	-	-	-	-	-	-	-	-	-	-	**0**
B21	-	-	-	1	-	5	-	1	-	-	-	-	**7**
B24	-	-	-	x	-	17	-	-	-	-	-	-	**17**
BM1	-	-	-	-	278	1032	-	-	-	95	-	-	**1405**
Sum	**1**	**7**	**7**	**52**	**359**	**1141**	**1**	**3**	**1**	**97**	**3**	**10**	**1682**

The large number of stone artefacts at Sun Shadow's house area S1 is probably because the excavation here was more extensive (around 150 m^2). Most of the other excavations only exposed the house floor and a small area beyond; usually, these excavations did not exceed 16 m^2 per house area. If most of the activities with stone artefacts took place outside of the houses, it may be no surprise that few stone artefacts were recovered from the limited house excavations. In other words, we may be looking at the spurious results of the excavation strategy rather than any meaningful cultural pattern in stone artefact use at Sun Shadow. Beyond that, it is noteworthy that bog iron and iron stone were only found at Sun Shadow, as were burnishers. These may point to specialised activities at certain houses in this compound.

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[1] Relatively few grindstones were collected, but many were mapped.

At Boschoek, on the other hand, stone artefact diversity is relatively low. Over 90% of the stone artefacts came from the excavation of the Boschoek midden and not from the house areas. This again suggests that most of the stone tools were being used outdoors when the site was abandoned. More than two-thirds of the stones from the midden, however, were manuports, with the remaining majority comprising flaked stone. These manuports were predominantly small pebbles (approximately 5 mm in length) that appear natural and need not have been collected. There were a notable number of crystals recorded within the midden materials, but a closer look revealed that they are in fact fragments of clear quartz.

Fauna

The faunal remains from these two compounds have not been analysed by a specialist; we only have bone counts. Nevertheless, these reveal interesting distributions (Table 4). Sun Shadow produced a little under one-third of all the faunal remains from these two compounds. All eight excavated house areas produced bone, but in notably different quantities. The house S1 area, which was the largest excavation, produced surprisingly little bone; however, house S6, which had a wealth of metal artefacts and beads as described earlier, also had the highest number of bones: nearly one-fifth of all the bones from the two compounds. The correlation between beads and bones may be spurious though, since it cannot be seen in the other house excavations: house S2, for example, which has the second highest number of bone fragments at Sun Shadow, contained very few beads and metal items. Without a more detailed analysis, it is difficult to know what the large number of bones at house S6 may signify.

Table 4. Fauna recovered from Sun Shadow (S) and Boschoek (B). Note that the counts include whole and fragmented pieces.

House	Bone	Ostrich eggshell	Ivory	Sum
S1	15	-	-	**15**
S2	48	-	-	**48**
S3	1	-	-	**1**
S5	7	-	-	**7**
S6	196	-	-	**196**
S8	3	-	-	**3**
S19	29	-	-	**29**
S21	5	-	-	**5**
B1	22	-	-	**22**
B2	20	-	-	**20**
B3	27	40	-	**67**
B4	27	-	-	**27**
B5	5	-	-	**5**
B7	55	8	-	**63**
B9	1	-	-	**1**
B10	1	-	-	**1**
B13	38	-	-	**38**
B14	24	-	-	**24**
B15	63	-	100	**163**
B16	48	18	-	**66**
B18	52	260	-	**312**
B19	4	-	-	**4**
B21	41	-	-	**41**
B24	109	-	-	**109**
Sum	**841**	**326**	**100**	**1267**

A few of the house areas at Boschoek produced no bone at all. At the other extreme, the highest number of faunal remains here came from house B15, and two-thirds of these were fragments of ivory. Like the hoard of iron at house S6 in Sun Shadow, this unusual wealth of a presumably valuable material may point to craft specialisation or a stash of private resources for trade and exchange. A closer examination would be required to ascertain whether the ivory was unworked, or whether it consisted of fragments of a finished product, such as bangles. Curiously, the largest quantity of unworked ostrich eggshell comes from two houses near B15, so this south-western (lower left) quadrant of the compound contains high numbers of unusual faunal remains, and some of the occupants of the houses here may have been involved in producing bone and shell ornaments (Fig. 7).

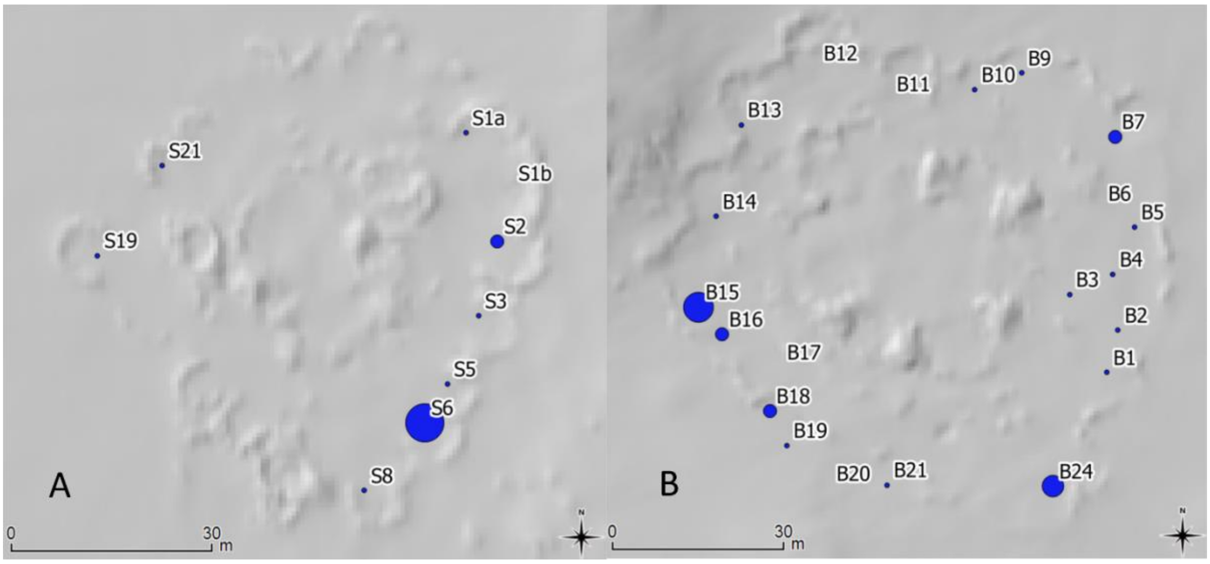

Figure 7. The distribution of all collected faunal material from excavated houses at Sun Shadow (a) and Boschoek (b). The size of the circle indicates the number of objects from each house excavation; see Table 2 for details. The finds from the Boschoek midden have not been indicated.

In terms of actual animal bones, house B24 in the south-eastern quadrant produced the largest number of faunal remains (Table 4). More faunal material came from the midden, but it has not been included in Table 4 as the counts were incomplete. While examining the collection, a human mandible was encountered in the sample and the first author did not have ethics clearance to analyse human remains, so four boxes of faunal remains from the midden were not studied. It is estimated that this would have added another 500-1000 bone fragments to the data base.

Pottery

There is much to be said about the ceramic collection from these two compounds, but here we will only look at the general distribution of this class of artefact. A detailed typological and spatial analysis of the pottery distribution will be presented in a forthcoming article. The Sun Shadow collection contained 62 whole or partial ceramic vessels, whilst Boschoek contained 139. The average number of ceramic vessels per house is seven or eight pots of various sizes. Around one in four pots were decorated; however, as with the other classes of artefacts examined so far, the ceramics are not evenly distributed across the two compounds, and the anomalies in the spatial patterns provide interesting clues to the activities and social organisation of space.

For the analysis here, we report on the number of potsherds rather than on the distribution of whole vessels (Table 1). In addition, we mention a few unusual ceramic objects. On average, each house area excavation in Sun Shadow produced about 475 potsherds, while in Boschoek the equivalent count is only about 230. It seems probable that not all potsherds excavated at Boschoek were collected. The house S1 area produced about half the sherds in the Sun Shadow collection, and this is certainly a result of the large area excavated. At Sun Shadow, houses S2, S5, S6 and S21 contained an average number of sherds, while houses S3, S8 and S19 had fewer than expected (Fig. 8). It may be that many pots from these houses were in use outdoors at the time, and so were not encountered in the house excavations. House S8 produced the only ceramic pipe bowl found in these collections (Fig. 9a).

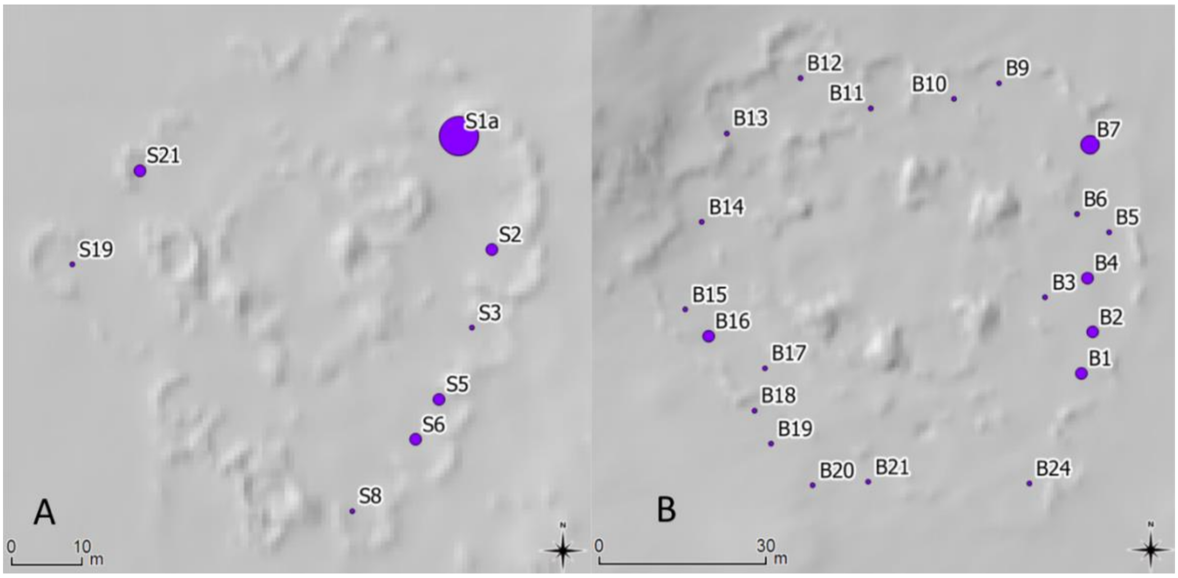

Figure 8. The distribution of all potsherds from excavated houses at Sun Shadow (a) and Boschoek (b). The size of the circle indicates the number of objects from each house excavation; see Table 2 for details. The sherds from the Boschoek midden have not been indicated.

Figure 9. Ceramic pipe bowl found in Sun Shadow house S8 (a); ceramic figurine of an animal (b); broken pedestal base (c); and double cone-shaped object (d). The latter three objects are from the Boschoek midden.

At Boschoek, slightly less than a third of the potsherds came from the midden excavation. The midden also produced some unusual ceramic objects (Fig. 9b-d). The double cone-shaped object is also known from the contemporary sites of Lebenya (Jordaan 2016), Olifantspoort 61/71 and Suikerbosrand 103/73 (Mason 1986). The broken pedestal base (Fig. 9c) is like objects reported from Lebenya (Jordaan 2016), Klipriviersberg and Suikerbosrand 103/73 (Mason 1986). This may be what Maggs (1976a: fig. 43 no. 4, fig. 59 nos. 1 & 17) refers to as a pedestal cup: a characteristic southern Sotho ceramic form. Another possibility is that it is a pot lid knob (cf. Mason 1986; Pistorius 1992: plate 13). The ceramic figurine (Fig. 9b), which is missing its head and its hind legs, is similar to objects found at Klipriviersberg 31/78 and Suikerbosrand 103/73 (Mason 1986; Pistorius 1992: plate 16). Beyond the midden, house B7 produced an inordinately large number of potsherds (Fig. 8b), while at the other extreme, houses B9, B11 and B20 had none, or just one sherd. In general, the houses on the right-hand side of the Boschoek compound seem to have produced more sherds.

Building Material

Various classes of finds in the collections from Sun Shadow and Boschoek can be described as building materials. This includes fragments of mud wall (*daga*), wood, reeds, charcoal (from burnt doors, posts, and roof beams) and thatching slag (from burnt thatched roofs). In addition, the field maps of the excavated houses showed the location of other building features such as doors and door slides. The distribution of these materials is shown in Table 5 and described below.

Table 5. Building material recovered from Sun Shadow (S) and Boschoek (B). Those recorded on excavation maps or post excavation photos, but not included within the collection, are denoted by 'x'.

House	*Daga*	Reed	Wood	Charcoal	Thatching slag	Door slide	Sum
S1a	45	x	x	373	-	-	**418**
S2	-	-	-	1	-	-	**1**
S3	-	-	-	-	-	-	**0**
S5	-	-	7	3	-	-	**10**
S6	-	1	-	149	-	-	**150**
S8	-	-	164	27	-	-	**191**
S19	-	-	-	-	-	-	**0**
S21	-	-	-	x	-	-	**0**
B1	-	-	x	-	-	-	**0**
B2	-	-	-	-	-	-	**0**
B3	1	-	-	-	-	-	**1**
B4	-	x	-	x	-	-	**0**
B5	-	-	-	-	-	x	**0**
B6	-	-	-	-	-	-	**0**
B7	-	-	x	-	-	-	**0**
B9	-	-	-	-	-	-	**0**
B10	-	-	-	-	-	-	**0**
B11	-	-	-	2	-	-	**2**
B12	-	-	-	2	-	-	**2**
B13	5	-	14	-	-	x	**19**
B14	-	-	-	x	-	x	**0**
B15	6	-	-	-	10	-	**16**
B16	-	x	-	1	-	x	**1**
B17	3	x	-	-	-	x	**3**
B18	-	-	-	-	-	-	**0**
B19	-	x	-	x	-	x	**0**
B20	-	-	-	-	-	-	**0**
B21	-	x	x	x	-	x	**0**
B24	-	-	3	-	-	x	**3**
BM1	-	-	1	5	-	-	**6**
Sum	**60**	**1**	**189**	**563**	**10**	**0**	**823**

Daga: The houses at these two compounds seem to have been mud-walled and thatch-roofed, cone-on-cylinder structures. The excavations laid bare the *daga* floors and often also the basal portion of walls.

Most houses had a low centre dividing wall (*borobalo* in Setswana, see Frescura & Myeza 2016) made of *daga*. Although ubiquitous, *daga* was only collected from a few houses so the presence of this material in the collection does not provide information on its actual distribution at the site. Some of the collected fragments of *daga* had clear reed impressions, and this may explain why they were collected.

Reeds: Several house maps show the position of reeds as recorded during the excavations. Some houses, such as B17, show a line of reeds on the interior part of the house wall, suggesting that a screen of reeds may have covered and perhaps decorated the interior walls of the house. In other houses, such as B21, the reeds seem to have been set within the mud wall, probably forming the reed core of a wattle-and-daub wall construction (Frescura & Myeza 2016). In house B16, the back wall was apparently made only of reeds without any *daga* packing, while the front half had a clay wall. Interestingly, four of the five houses that showed reeds on their maps are clustered in the south-western quadrant of Boschoek. It is not clear whether this means that the other houses at Boschoek did not make use of reeds in their architecture, or whether reeds simply were not recorded there by the excavators. At Sun Shadow, only the map of house S1b shows reeds, and these are in the front courtyard wall rather than in the house itself. All in all, a confident conclusion cannot be offered, but there are hints that the use of reeds in house architecture was not a standard feature, and perhaps serves as an identifier of variations in architectural traditions among the inhabitants of the compounds.

Wood: Several house maps show wooden posts, and the best-preserved samples of this material seem to have been collected. These are now in a fragmentary state, with counts indicated in Table 5. In this table, the houses with an ‘x’ in the column for wood are the ones with field maps indicating that wood was present, but apparently none was collected. On the house maps, a central post (*pinagare* in Setswana, see Frescura & Myeza 2016) is often indicated, set in the central dividing wall. Wooden posts are also sometimes shown flanking the entrance to the house. These were presumably the jambs for the sliding doors which were made of wood. Curiously, the collection from house B24 also contains a (cattle?) horn, with a label stating it was used as the back post for the sliding door to the house. The wood fragments from B13 include a piece that is clearly from a door and not from a post. The map of house S8 shows that the wood fragments came from the entrance of the house and indeed one of the bags from this collection is labelled ‘door’. Given that all the houses at Sun Shadow and Boschoek seem to have been mud-walled and thatch-roofed, cone-on-cylinder structures, wood must have been used in the construction of all of them. The fact that some of the house maps show no indication of wood is therefore likely to mean that either the wood had completely burnt to ash, or that it was so fragmentary that the excavators did not record it.

Charcoal: Much the same can be said about charcoal. Since it appears that cattle dung formed the principal fuel for cooking, heating, potting and ritual fires in this area (Chingono & Sadr 2023), it is probable that the charcoal fragments found in the houses originate from the burning of the wood that was used in their construction. One might have expected that all the houses would contain some charcoal fragments, but this is not the case. As with the wood, it is likely that the absence of charcoal simply means that either it was burnt to ash or that it was too fragmentary to record. Given the highly variable quality of the field maps, it is also possible that some excavation crews were not assiduous in recording their observations.

Thatching slag: The collection of materials from house B15 includes thatching slag, a residue from the burnt house roof. It is somewhat surprising that none of the other houses produced this material, but this may be due to how slag is formed, or the excavator’s lack of familiarity with this unusual material.

Door slide: The wooden door of some pre-colonial Batswana houses had a grooved slide to guide it into position (e.g., Mason 1986; Pistorius 1992: plate 12; Maggs 1993). In some cases, these slides are made of stone, and in others they are clay features. Several house maps at Boschoek indicate the presence of such door slides, but the material from which it was made is not specified, and none were collected. Two of the houses, B5 and B16, show a step at the entrance instead of a door slide, but this may in fact point to the same feature. None of the house maps from the eastern side of Boschoek indicate any door slides; if this is not due to oversight, it may indicate that a different type of door was in use here, which may indicate variations in architectural tradition among the inhabitants. At Sun Shadow, eight of the nine houses excavated had stone or clay door slides. These are not clearly indicated on the excavation maps, but they are shown on post excavation photos of the houses. House S6, which contained an unusually large number of beads and iron artefacts, stands out as the only one to be excavated at Sun Shadow with no indication of a door slide or step at the entrance.

Stone underflooring: Only house B9 was recorded as having a stone slab underflooring, and this pavement left spaces for internal dividing walls and a space for a door slide. Similar stone underflooring was reported by Mason (1986) at two of the 12 excavated huts[2] at the Suikerbosrand site 103/71, approximately six kilometres south-east of Boschoek. He interpreted the stone underfloor to represent an earlier house that was then rebuilt with a clay floor. Another possibility is that the stone acted as a foundation for the raised clay floor. In either case, the other houses in both Sun Shadow and Boschoek were seemingly built directly onto the ground, with no intervening stone layer. The rarity of collected artefacts from house B9 (just a single bone fragment) may suggest that either this house was under construction, or that it had already been abandoned when Boschoek was burnt down.

4. Discussion

Overall, the architecture of the two compounds, their location within the same neighbourhood and the types of finds excavated from each, suggest that they were contemporaries. Both had burnt down in the terminal phase of settlement and the inhabitants never came back to salvage their belongings. The finds from the two compounds thus represent a snapshot in time, with all objects left where they were at the time of abandonment. Kent Rasmussen (1978) concludes that Matabele invaders reached the Vaal River in August 1823 and that they drove the Bakwena Bakhudu out of the Suikerbosrand region late that same year, so we presume Kweneng was abandoned in late winter or spring of that year. Given the presence of much material in the front courtyard of house S1 at Sun Shadow, we assume the abandonment took place in daylight hours when activities were taking place outdoors. Thus, our sample of finds from these two compounds is highly biased, because the primary excavations took place in house floor areas and most of the collected artefacts come from within the houses. What is lacking is equivalent exposure beyond the house into the open yards, both in front and behind the houses, where most daily activities would have taken place. This bias cannot be rectified until further excavations are carried out at these compounds. Until then, it would be premature to draw any definite conclusions about the social organisation of space in these two compounds, although several hypotheses can be generated from the data for future testing.

The focus on the excavation of houses, for example, does allow us to estimate the size of the population that lived at Sun Shadow and Boschoek, and to present a hypothesis on the organisation of households within the compounds. Given the size of each excavated house floor – about 2-3 m in diameter – we estimate that, on average, two people would have slept in each. This figure tallies well with the census provided by Schapera (1935) for Ramoseki ward in Serowe, Botswana, where 51 houses sheltered a total of 95 people: 58 adults and 37 children. Schapera counted some houses where three individuals slept: some contained two adults and an infant; others housed a mother and two children, while some were occupied by three girls. Many houses were occupied by a man and wife, and some by a single individual. Indeed, a few houses were unoccupied and used for storage.

Using Ramoseki ward as an analogy, we can hypothesise that our two excavated compounds, with their ca. 25 houses each, might have sheltered around 50 souls. Another approach to counting residents in these compounds is to count the kitchens or cooking areas, as suggested by one of the reviewers of this paper. Huffman (1986, 1988) suggested that the small stone circles between the houses and central

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[2] Schapera, along with most anthropologists and archaeologists working in southern Africa, used the word hut to refer to the traditional African domicile. We prefer to use the nomenclature from Frescura and Myeza (2016) who make a clear distinction between house and hut. The distinction is also made in Setswana, where a house is referred to as *ntlo* and a hut as *mogope* (Brown 1987). Interestingly, the same distinction was made in pre-colonial times by European travellers such as William Burchell (1824) and John Campbell (1822), but in colonial times European writers regularly belittled traditional African houses by calling them huts.

kraals represent kitchens or cooking areas. These were perhaps roofless, with the low walls serving as, or anchoring, wind breaks (Taylor 1984). Only one of these features was excavated – the kitchen feature associated with house B4 – revealing coal (charcoal), ash and several potsherds all within a scattered one-course high stone circle that was possibly used to shelter a fire from the wind, or to stop it from spreading. If indeed they were cooking areas, we cannot tell if all of them were used as such in the terminal phase of these compounds. Furthermore, there is a possibility that some houses had open cooking areas (cf. Maggs 1976a). But assuming for now that the small stone-walled kitchens are a useful indication of population size, we note that Boschoek contains 21 such features. If all were in use at the time of abandonment, it might suggest the presence of 21 wives. The number of their children can only be estimated, but an average of two per wife may be a reasonable assumption. The same reviewer also suggested that the number of cattle kraals may indicate the number of husbands residing at Boschoek. Again, the identification of these and their distinction from pens exclusively for small livestock and for calves is not unproblematic. Furthermore, there is the possibility that some of the central stone circles served as exclusive meeting places rather than animal pens (cf. Pistorius 1992). Be that as it may, the reviewer estimated around five to seven husbands at Boschoek, based on the number of livestock pens. All this would add up to a total of 47-49 souls residing at Boschoek, which is close to the estimation based on Schapera’s (1935) census data from the Ramosedi ward in Botswana.

The ring of houses around the central livestock pens, at the archaeological compounds, resembles the layout of the two wards mapped by Schapera (1935). He defined a ward as "...a collection of households living together in their own hamlet, and forming a distinct social and political unit under the leadership and authority of a hereditary headman..." (Schapera 1938: 19). Although Ramoseki and Ramopedi wards contained more inhabitants (95 in one and 106 in the other), the estimated population of each of our two archaeological compounds fits comfortably in the lower end of the range of Batswana ward sizes as reported by Schapera (1935). Consequently, we can propose that our two compounds each represent pre-colonial examples of a Batswana ward. In Setswana, each compound could thus be referred to as a *kgotla*, a *kxoro* or a *motse* (Schapera 1935). The choice of words seems to be a matter of local usage and we cannot know which label was preferred by the inhabitants of Sun Shadow and Boschoek.

To estimate the number of households at Boschoek, we can again propose different approaches. According to Schapera (1935: 214), a household is a subset of the ward and can be defined as “a man with his wife or wives and dependent children, together with any other relatives or unrelated dependants, married or not, who may be attached to him”. In Mochudi’s Ramopedi ward, the 106 inhabitants were divided into 16 households, while at Serowe’s Ramoseki ward, the 95 inhabitants lived in 18 households. At Ramoseki, most of the households had two or three adjacent houses; one of them had a single house and two had, respectively, five and six houses each. Using the figures from Ramoseki and Ramopedi wards as an analogy, we can propose that each of our two archaeological compounds contained 7-10 households. This assumes, of course, that the precolonial composition of Batswana households in the Highveld resembled those in the Bechuanaland Protectorate of the 1930s. This is by no means certain since polygamy had gone out of fashion in the 1930s. It is therefore probable that the pre-colonial polygamous households at Kweneng were larger than those of Ramopedi and Ramoseki wards, so seven households can perhaps be considered a maximum in each of our two archaeological compounds.

Following archaeological household examples found in Pistorius (1992, 1994), Anderson (2009) and Jordaan (2016), and from ethnographic descriptions given in Molema (1920), Hoernlé (1962) and Schapera and Goodwin (1962), as well as the shape of the perimeter wall of the compounds, Hodgson (2021: figs 4.1 & 4.2) proposed six households (house clusters) at Sun Shadow and five at Boschoek (Fig. 10a). For a variation on Hodgson’s hypothesis, one of the reviewers of this paper proposed six households at Boschoek, based on “…the ‘flow’ of the back walling” (Fig. 10b). Another approach is based on the excavated finds from the different houses (Fig. 10c). For example, the distribution of artefacts at Boschoek shows two distinct hotspots, one on the eastern (right-hand) side of the compound (B1-B8) and one on the south-western (bottom left) side (B15-B19). These might represent separate households, while the houses with few artefacts in the northern and southern section of the compound may represent other households. Although the residual doubt created by the biased sampling makes this kind of reconstruction highly provisional, future excavations and more detailed artefact distribution studies, especially of ceramic vessels, might allow us to arrive at an artefact-based model for household distributions at Boschoek that complements the approach based on the morphology of the perimeter wall.

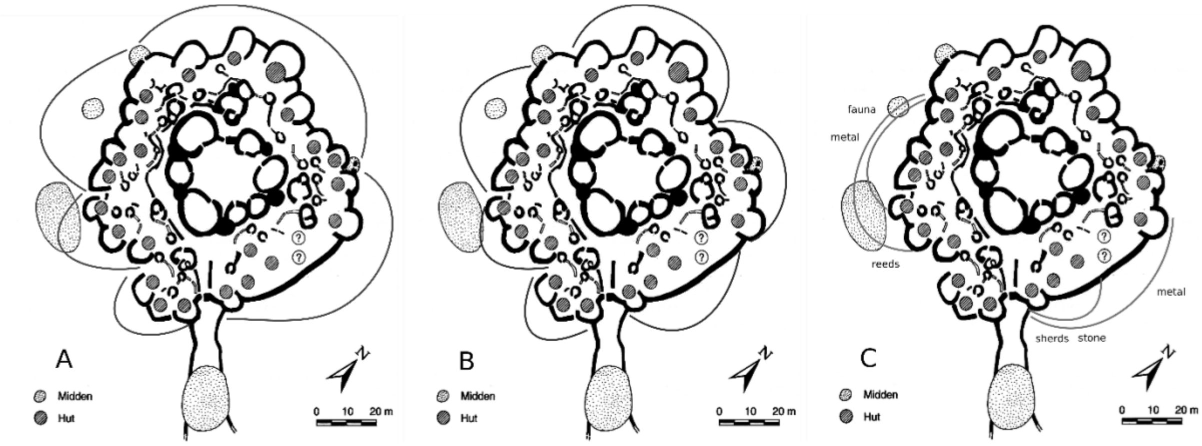

Figure 10. Possible households at Boschoek. Hodgson's (2021) proposed distribution of households (a); a household distribution model suggested by one of the reviewers of this paper (b); partial indication of possible households based on the frequency distribution of excavated artefacts (c). Background map of Boschoek modified from Huffman (2007).

5. Conclusion

This article aimed to identify and explain the similarities and differences between two neighbouring Late Iron Age compounds that had been excavated a few decades ago at the foot of the Suikerbosrand massif, south of Johannesburg. The results of this study revealed some interesting differences between the compounds, and between the excavated houses within the compounds. We were able to favourably compare the compounds with wards, as defined by the ethnographer Isaac Schapera during the first half of the twentieth century at Batswana settlements in what was then called the Bechuanaland Protectorate. Using his ethnographic writings as well as archaeological examples, we can begin to distinguish separate households within the wards, based on the frequencies and types of artefacts found in the houses. Our reconstructions and interpretations are preliminary due to the incompleteness of the record and the lack of information on sampling and collection strategies at these sites during their excavations in the 1980s and 1990s. Nonetheless, the exercise has not been fruitless, and this paper confirms the value of diving deep into the under-analysed archaeological collections at Wits. In this respect, we applaud Aron Mazel and Jannie Loubser's call to arms from three decades ago and recommend such similar studies in the future. As a next step, we will pursue our aim of distinguishing the separate households within the two excavated wards of Boschoek and Sun Shadow through a detailed analysis of the more than 8000 potsherds excavated there.

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USING AERIAL SURVEY TO RECORD NEW SITES IN THE KEIMOES KITE LANDSCAPE OF SOUTH AFRICA

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ABSTRACT
The recent identification of kite sites on the Keimoes landscape, in the Northern Cape Province of South Africa, has shed light on how past populations built and utilised low stone structures to funnel and capture game. By strategically identifying and using certain aspects of the surrounding landscape, in conjunction with key design aspects, local groups maximised hunting proficiency. With this contribution, we revisit the Keimoes landscape to continue our search for more funnel sites and to establish whether there is consistency in some of their key design aspects, as identified in earlier publications. We introduce three more kite sites and provide their morphological and landscape details. For the first time, we also demonstrate that some of the kites were purposefully located near rocky outcrops from which construction material could be collected.

Keywords: Keimoes, desert kites, hunter-gatherers, Stone Age hunting, strategic landscape use

1. Introduction

Over the last few years, the first kite-like structures from the southern hemisphere have been reported on the northern edge of the Nama Karoo Biome near Keimoes, in the Northern Cape Province of South Africa (Fig. 1a & c; van der Walt & Lombard 2018; Lombard et al. 2020, 2021). These structures are described as low, stone-walled V-shaped funnels, at times covering several hundred square metres with long converging guiding arms that sometimes end in a round enclosure or 'head' (Fig. 1b). These reports provide detail on the characteristics of funnel construction, function, chronology, and site placement relative to the local landscape. They also extended the geographical range for kite-like structures beyond those found in the arid regions of southwest Asia (e.g., Nadel et al. 2010; Bar-Oz et al. 2011; Crassard et al. 2015; Fradley et al. 2022; Barge et al. 2023), or the reindeer hunting and herding funnels of Scandinavia (Ingold 1986; Sommerseth 2011; Jordhøy & Hole 2015; Solli 2018). In terms of their functionality, kites or kite-like structures are most frequently considered as hunting traps (Holzer et al. 2010), where ungulates – such as springbok in the case of the South African funnels (see Lombard & Badenhorst 2019) – would have been guided between the funnel arms. It is, however, also possible that they were used for some forms of animal husbandry (e.g., Ingold 1986; Sommerseth 2011; Crassard et al. 2015). Identifying who made them, and when, from a southern African perspective is challenging because their construction is more informal when compared with Iron Age, or farmer, stone walling further east in the higher rainfall zones (i.e., organised, stone-packed and coursed, e.g., Huffman 2007), and the general lack of associated surface archaeology, faunal and datable materials make it difficult to establish group identities and chronologies (Lombard et al. 2020, 2021). The Keimoes kites represent fixed features on the landscape in a region that has been occupied by both hunter-gatherer and herder groups over the last 2000 years (Orton & Parsons 2018). It is most likely that they were used and managed by multiple groups over time, possibly handed down through generations, and their construction appears to be consistent with Holocene Later Stone Age (LSA) structures that post-date the last 2000 years (see discussion in Lombard et al. 2020 and 2021).

The Keimoes kite studies are the result of a project that aims to expand our understanding of Stone Age communities on the grass/shrublands of South Africa. Through this endeavour, five kite sites (Fig. 1c) have been reported, with the first two (Keimoes 1 & 2) having been identified by environmental specialists during aerial survey work. These kites were subsequently investigated by van der Walt and Lombard (2018), through both ground- and aerial-based surveys, confirming that southern Africa, and specifically the desert-like Nama Karoo north of the Gariep (Orange River), preserved kites similar to those reported in the northern hemisphere. Following their findings, Google Earth surveys were executed across the broader region to establish whether more structures could be located, leading to the identification of Keimoes 3 (the largest of the Keimoes kite sites). Given the general difficulty in documenting these sites through traditional ground-based survey and recording methods, Lombard et al. (2020) commissioned aerial LiDAR scanning to retrieve detailed landscape data from which kite placement, microtopography, and function could be investigated. Once again, and during expanded Google Earth surveys of the broader region, Keimoes sites 4 and 5 were located (Lombard et al. 2021).

As a result of these recent findings, new questions arose about the Keimoes landscape. Are there more sites in the broader region? Could more sites be identified if a more systematic aerial surveying strategy was implemented? It is clear from previous studies that when more aerial surveying was conducted, more sites were being located, making it reasonable to assume that zooming out from the landscape and covering more of the surrounding region would yield positive results. Doing so led to the identification of three additional kite sites in the extended region. It was not immediately clear, however, whether these new sites would be similar to those already reported, and if they would be associated with specific landscape features (e.g., nearby pans, as has been reported for sites 1-5; Lombard et al. 2020, 2021). With these questions in mind, the purpose of this paper is to present the results of our systematic aerial survey of the Keimoes landscape and to provide the morphological and landscape details of the newly located Keimoes sites 6-8. We continue to build upon research that considers the strategic settings of the sites by assessing their placement on the landscape in terms of elevation, landscape and visibility characteristics.

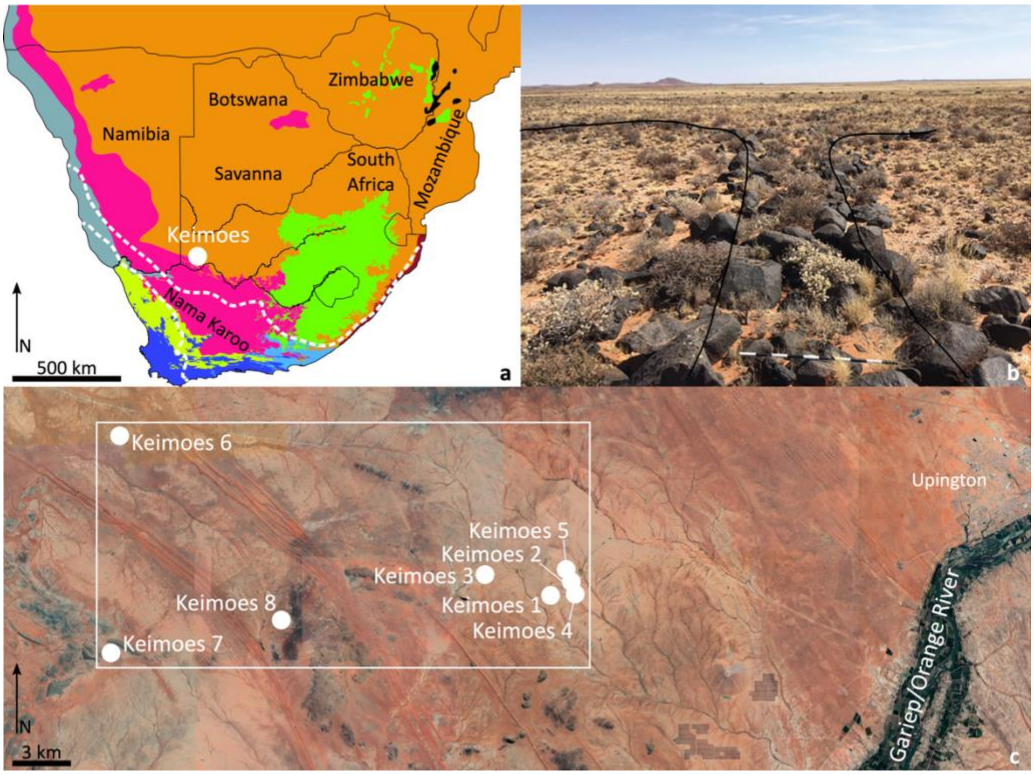

Figure 1. Map of southern Africa showing relevant biomes and rainfall regimes (between dashed lines=year-round rain, below bottom dashed line=winter rain, above upper dashed line=summer rain), and the location of Keimoes (a). View of the Keimoes landscape and kite stone walling, with kite funnel arms indicated in black (b; modified from van der Walt & Lombard 2018, photograph by Jaco van der Walt©). Location of the Keimoes kite sites west of the Gariep (Orange River), with the newly reported sites (6-8) representing the most western in the region (c).

2. Methods

Aerial (orthographic) survey

Since random Google Earth surveys had already yielded positive results, we conceptualised a systematic survey strategy covering the greater Keimoes region. Our survey area included the known Keimoes sites, as well as other LSA sites in the broader region that dated from the last millennium BC into more recent periods, the premise being that unrecorded stone structures may occur within the vicinity of known sites (see Fig. 2a for sites; Humphreys & Thackeray 1983; Parkington 1984). These sites contain stone tool assemblages that fit either the Doornfontein or Swartkop Industries, and they also preserve ceramics and faunal collections (Parsons 2007; Badenhorst et al. 2015). The farm Dröegrond/Graafwater was also included in the survey area given reports of a kite on the property, albeit in an unknown location (Beaumont et al. 1995). To include all these localities a total area of approximately 60 x 300 km (~16324 km^2) was identified, subdivided into 10 x 10-minute grid squares, and labelled alphabetically from west to east and numerically from north to south (Fig. 2a).

Aerial Google Earth surveys commenced following a standardised approach. The viewing angle was set perpendicular to the ground (vs. oblique) and the survey area was always orientated north up. Surveying (eye) altitude varied depending on landscape surface visibility but was predominantly in the range of ~1 (survey area of ~0.8 km^2) to <2 kms (survey area of ~3 km^2). These thresholds were identified by surveying the known Keimoes sites and establishing the maximum altitude at which features could be confidently identified; historic aerial imagery was overlaid, when needed, for improved site visibility. Surveys began in the northwest corner of each square and proceeded in transects running north-south, completed while moving in a west to east direction with approximately 30% overlap between transects. To ensure transects were straight, cursor movement keys were used to pan versus panning with a mouse or using the built in Google Earth navigator. Tracking pins were dropped at the end of each completed transect to ensure full survey coverage and adequate visual overlap between the transects. All features were recorded using numerically labelled pins in the order that they were used and according to the grid square code (e.g., a1.1, b1.2 etc.). By applying this approach, Keimoes 6 was identified by one of us (SB) in grid square k1, while the locations of Keimoes sites 7 and 8 were provided by Mr Walter Smit (Western Cape Government, Department of the Premier), also identified through desktop aerial survey.

Kite measurement protocols

To investigate the morphometric properties of the Keimoes structures, a series of morphometric measurements were recorded in Google Earth Pro using the path, polygon and measuring tools. Our measuring protocols follow those described in Lombard et al. (2021; Fig. 2b), for which the details are not repeated here, and we also apply descriptive statistics to assess the extent of morphometric funnel variability and standardisation.

Landscape analyses and functional interpretation

To investigate site placement relative to the topography of the local landscape (as explored in Lombard et al. 2020, 2021), elevation profiles were created in Google Earth Pro. The profiles comprise a single transect running between two points on the landscape, starting 500 m away from each funnel and moving towards the middle of the guiding arms, ending at the funnel head. Each profile output contains maximum and minimum elevations above sea level, in addition to positive/negative values for: elevation gain/loss (in metres), and maximum and average slope gradients (as percentages). The profiles themselves also provide a clear view of the landscape leading up to the funnels.

To assess the visibility of funnels on the landscape, shuttle radar topography mission (SRTM) DEM data (USGS EROS Archive n.d.) were analysed in ArcGIS 10.5 while using the line-of-sight function. Following the line-of-sight approach described in Lombard et al. (2020: fig. 6), visibility paths were created across the landscape when approaching each funnel from ~150 m away, with a viewpoint (eye-level) elevation set to 1 m (the average eye-height of a springbok). This provides a clear illustration of the visible/non-visible parts of the landscape around each funnel.

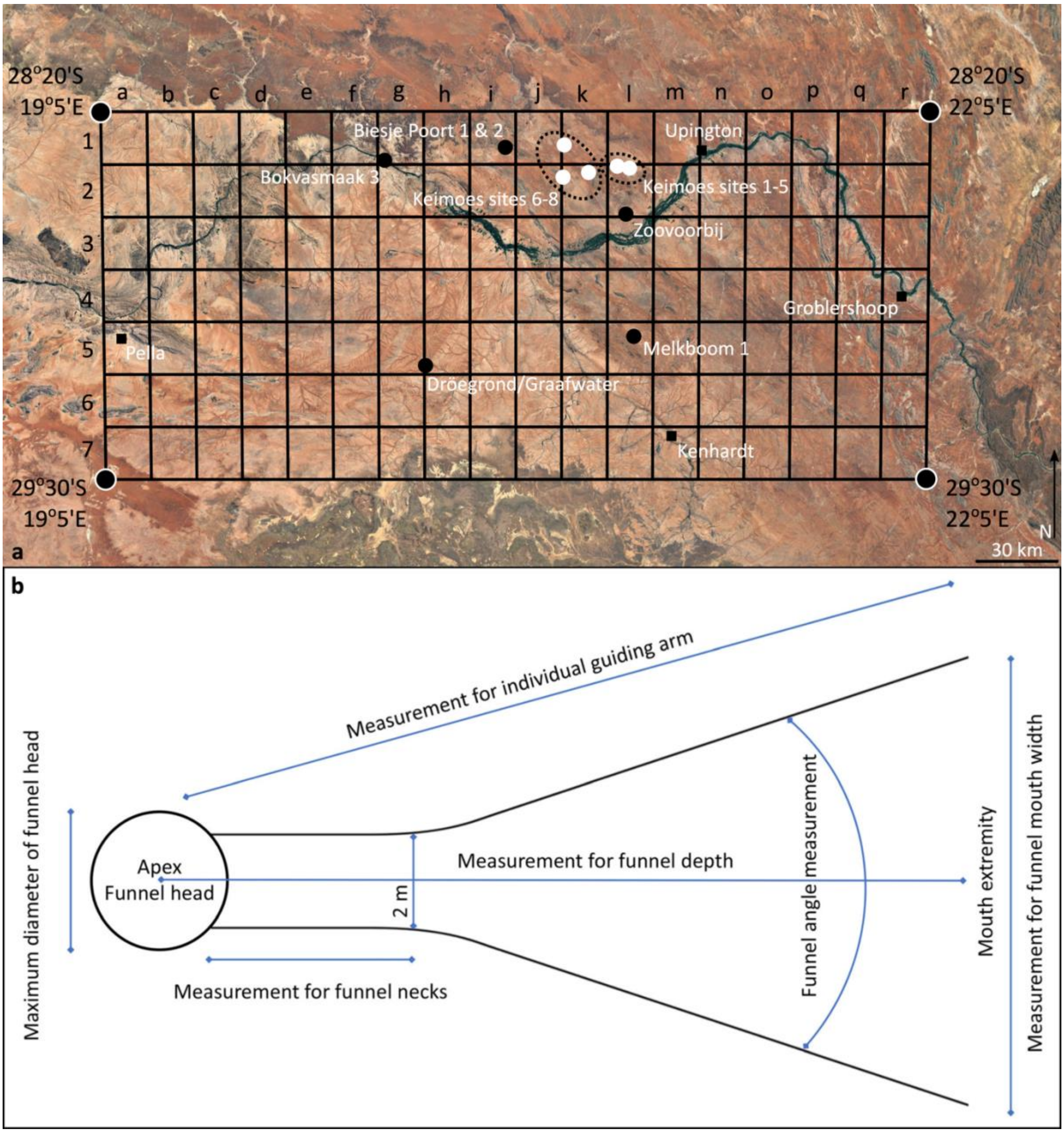

Figure 2. The Google Earth survey grid showing known site locations and the grid coding system (a). The Keimoes sites are shown by white dots whereas other known sites are shown by black dots; local towns are indicated by the black squares. Morphometric measurements (b) for the Keimoes kite funnels (from Lombard et al. 2021: fig. 2).

3. Results

Site descriptions and morphometric funnel characteristics

Although our study was completed remotely without ground truthing, it is possible for us to speculate on the construction of the kites based on earlier field observations and published descriptions for the five sites further east (van der Walt & Lombard 2018; Lombard et al. 2020, 2021). In general, the Keimoes funnels were constructed by sourcing local dolerite boulders and stacking them into funnel-shaped features, while also incorporating local outcrops where possible (for e.g., using *in situ* dolerite boulders in the walls of guiding arms, as described by van der Walt & Lombard 2018). The construction characteristics of the funnel walls differ by location, where the guiding arm extremities tend to reflect less-organised, single-tired boulder packing with lower wall heights (<0.5 m), in contrast to the funnel necks and heads that reflect more deliberate construction (i.e., vertical stacking and higher walls, much of which has subsequently collapsed). Some of the funnels have circular enclosures at their apices (van der Walt & Lombard 2018), while others may have screens or low walls protruding from their guiding arms (see Lombard et al. 2020).

Keimoes 6 is now the most northern Keimoes kite site and it occurs ~20 km northwest from Keimoes 3, while the Gariep is ~34 km to the southeast. The site occurs on sloping ground between two large drainage lines running southeast to northwest, away from the Gariep, and it comprises three separate funnels with a total of 453.1 running metres of walling covering an area of 3043 m^2 (Fig. 3; Table 1). In terms of arrangement, the funnel heads of kites 6b and 6c are within 40 m of each other, whereas 6a is roughly 100 m away to the northwest, collectively reflecting a somewhat clustered configuration. The funnels are all orientated differently: the funnel mouths for both 6a and 6c open towards the east, whereas 6b opens towards the southwest. Given these orientations, 6a and 6c open towards the drainage line to the north, roughly 700 m away, while 6b opens towards the larger southern drainage line, approximately 1.4 km away. Morphologically, the designs of the Keimoes 6 funnels are all similar, although there are some differences; all the funnels contain long guiding arms and narrower neck areas that end in characteristic, circular enclosures, which presumably have collapsed but have an average diameter of 2.5-3 m. Short guiding arm lengths range from 62.9 to 67.6 m, followed by long arm lengths ranging between 83.9 and 88.5 m, confirming that these Keimoes 6 funnels are the largest of the three newly reported sites. Although the difference in these ranges is small and reflects some consistency in size, the funnel surface area for 6b (1412 m^2) is considerably larger than that of 6a (894 m^2) and 6c (737 m^2). Funnel depths range from 64.8-70.7 m, neck lengths from 13.3-24.1 m, and mouth widths from 40-68 m (Table 1). All funnels have acute opening angles ranging from 20.7-53°.

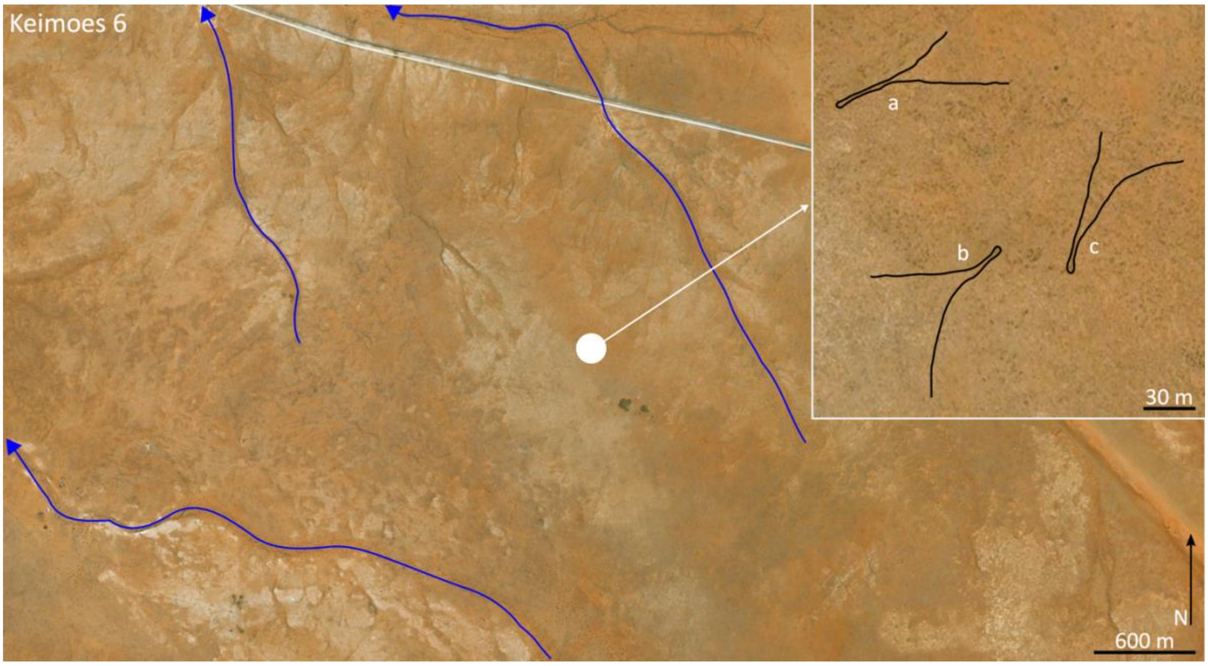

Figure 3. Aerial imagery of Keimoes 6 (white circle) and the surrounding landscape. Drainage lines are indicated in blue with drainage directions indicated by the arrows. The inset image shows the funnels outlined in black, where the funnel letters correspond with Table 1.

Keimoes 7 is equidistant from Keimoes 3 and it is now the most southern and western Keimoes funnel site, occurring within an area characterised by more irregular topography due to local bedrock exposures north, west, and east. The Gariep is 24 km to the southeast and the site occurs on sloping land adjacent to a small drainage line running north to south (Fig. 4). It comprises two funnels joined in a chain-like configuration, linked by their two short guiding arms that are 25.2 and 26.2 m, while collectively totalling 141.2 m of running walling and covering 365 m^2 (Table 1). The funnel mouths are both orientated the same way, opening to the south, thus facing the open ground to the west of the small drainage line and east of the crest of a small hill towards the southwest. Roughly 250 m to the northeast, a second drainage line occurs running parallel to the first, bisecting the high-lying outcrops to the north and extending uphill to a local drainage divide, which animals may have traversed while searching for alternative grazing/water sources. Morphologically, the funnels contain clear circular enclosures at their apices, with approximate diameters of 3.8 m (7b) and 4.9 m (7a). Long guiding arm lengths are 55.8 m and 34 m, followed by 26 m and 23.7 m for funnel depth, 8.4 m and 6.5 m for neck length, and 42.5 m and 20.4 m for mouth widths, for funnels 7a and 7b, respectively. Overall surface areas are largely comparable at 179 m^2 and 186 m^2, while opening angles are 40.6° and 63° (Table 1).

Table 1. Morphometric data for the Keimoes kite sites. For corresponding funnel letters, see Figs 3-5. Standardisation metrics for Keimoes kite sites 1-5 are provided below, for comparative purposes (SD=standard deviation, CV=coefficient of variation, *=incomplete, S.=short, L.=long, C.=combined). Note that incomplete funnels are excluded from standardisation metrics, and head diameters are approximate.

Site/ funnel	S. arm length	L. arm length	C. arm length	Funnel depth	Neck length	~Head diameter	Mouth width	Surface area (m^2)	Angle	Opening direction/ degrees
Keimoes 6 (3 funnels, with a total of 453.1 running metres of walling covering 3043 m^2)										
6a	62.9	83.9	146.8	66.4	24.1	2.5	40.0	894.0	20.7	ENE/67
6b	67.6	88.5	156.1	70.7	14.9	3.0	68.0	1412.0	53.0	SW/235
6c	63.2	87.0	150.2	64.8	13.3	2.5	42.4	737.0	32.0	NNE/24
Keimoes 7 (2 funnels, with a total of 141.2 running metres of walling covering 365 m^2)										
7a	26.2	55.8	82.0	26.0	8.4	4.9	42.5	179.0	63.0	SE/141
7b	25.2	34.0	59.2	23.7	6.5	3.8	20.4	186.0	40.6	SSW/207
Keimoes 8 (3 funnels, with a total of 155.8 running metres of walling covering 532 m^2)										
8a	12.2	24.5	36.7	16.3	4.8	3.2	23.2	188.0	57.9	WNW/291
8b	27.5	36.5	64.0	29.4	7.3	1.9	19.5	206.0	30.7	SE/129
8c*	4.7	50.4	55.1	10.4	13.5	2.9	46.2	138.0	17.6	SSW/207
Standardisation metrics for all complete funnels										
SD	22.9	27.7	50.2	23.6	6.7	1.0	17.3	485.7	15.8	-
Mean	40.7	58.6	99.3	42.5	11.3	3.1	36.6	543.1	42.6	-
CV	56.4	47.3	50.6	55.6	59.2	31.7	47.4	89.4	37.1	-
Standardisation metrics for Keimoes kite sites 1-5, as per Lombard et al. 2021										
SD	20.5	24.9	44.8	19.2	6.6	1.2	20.2	656.2	14.1	-
Mean	53.5	68.2	122.5	52.1	17.1	4.2	38.8	781.0	35.0	-
CV	38.2	36.5	36.5	36.8	38.5	28.8	52.1	84.0	40.4	-

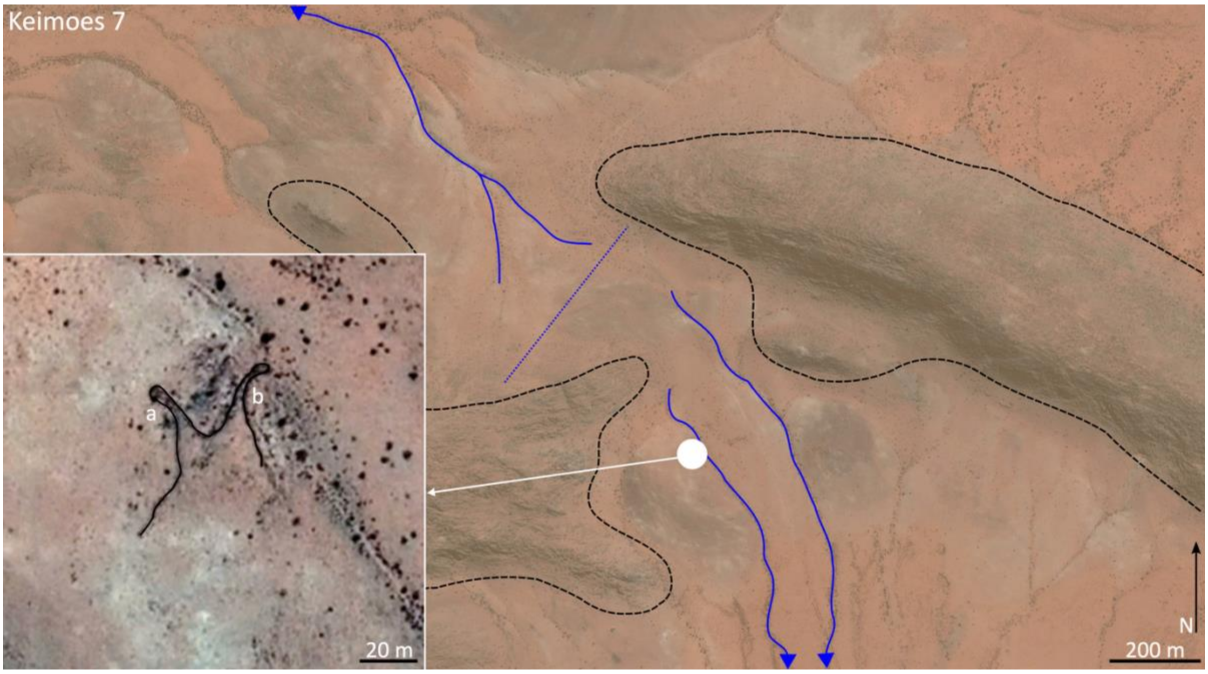

Figure 4. Aerial imagery of Keimoes 7 (white circle) showing nearby rocky outcrops (dashed lines) and main drainage lines (blue lines with arrows). The drainage divide is shown by the stippled blue line. Funnel outlines are provided in the inset image, in black. Note placement of the funnels adjacent to a small drainage line (east). Site and funnel letters correspond with Table 1.

Similar to Keimoes 7, Keimoes 8 also occurs in an area characterised by nearby rocky outcrops and drainage lines (Fig. 5). In fact, the site itself occurs on a small stone outcrop, while additional, larger outcropping hills occur ~300 m away to the northwest and ~650 m to the northeast. A drainage line running east to west occurs <50 m to the south, and this drainage line, once again, extends uphill to a local drainage divide. The Gariep, at its closest, is ~22 km away to the southeast, while the largest Keimoes kite site (3) is ~10 km to the northeast. The site comprises three funnels for a total of 155.8 running metres of walling covering 532 m^2: one small funnel isolated to the north (8a), covering 188 m^2, followed by two closely associated funnels 8b and 8c ~130 m to the south, covering 206 m^2 and 138 m^2, respectively, with the latter retaining one complete guiding arm, a funnel head, and then a second partially complete guiding arm (Fig. 5; Table 1). Similar funnels, incomplete and either poorly preserved or damaged versus being different features altogether, have been reported elsewhere on the Keimoes landscape (Lombard et al. 2020, 2021; see funnels 3m, 3n, 5a-c). All the Keimoes 8 funnel mouths open toward different directions. Funnel 8a opens west towards ground between it and the nearby hill, while 8b opens southeast towards the nearby drainage line; 8c, while difficult to establish, appears to face southwest where the drainage line spreads out into a network of smaller channels ~70 m away. Morphologically, the Keimoes 8 funnels are the smallest with long arm lengths ranging from 24.5-50.4 m, and 4.7-12.2 m for short arm lengths. At the funnel apices, circular heads are visible with diameters ranging from 1.9-3.2 m, coupled with narrowed neck lengths from 4.8-13.5 m (Table 1). Funnel depths are short, from 10.4-29.3 m, while mouth width ranges from 19.5-46.2 m. Funnel opening angles range from 17.6-57.9° (Table 1).

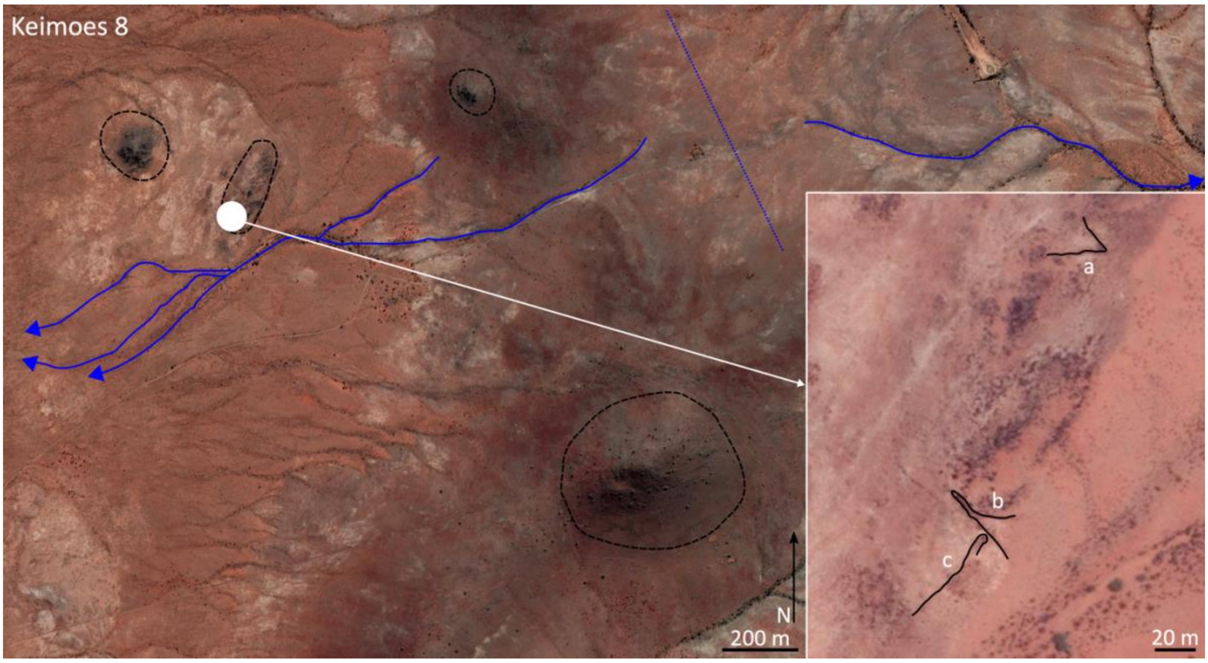

Figure 5. Aerial imagery of Keimoes 8 (white circle), comprising two complete and one incomplete funnel (outlined in black). The site occurs on a rocky outcrop (dashed lines) and close to a main drainage line (blue lines with arrows). The drainage divide is shown by the stippled blue line. Site and funnel letters correspond with Table 1.

The calculation of standardisation metrics illustrates some trends that are consistent with those reported earlier for sites 1-5 (in Lombard et al. 2021). Accordingly, the least variable feature of the newly reported funnels is the diameter of the funnel heads (CV=31.7), which was also the case for sites 1-5 (CV=28.8). The inter-site trend for less variability continues for angle, and long and combined arm length measurements (Table 1). For all Keimoes kite sites, the most variable feature is funnel surface area (CV=89.4; 84 in Lombard et al. 2021). Overall, though, there is little evidence of standardisation in the construction of the kite funnels, as reflected in the relatively high CV values (equal to or greater than 31.7). Based on the new morphometric values provided here, we are now also able to update the minimum construction criteria that we believe likely influenced effective funnel function, as presented in Lombard et al. (2021), namely: a funnel depth of at least 16.3 m, a mouth width of at least 13 m, a surface area of at least 78.5m^2, and an opening angle of no less than 18.3°. Funnel necks need to be at least 4.8 m long while head diameters need to be 1.9 m or larger.

Site placement, visibility, and landscape topography

By assessing the character of the landscape at each site, Figure 6 confirms that most of the funnel heads are constructed in areas of higher elevation relative to where the openings of the guiding arms were placed. This is clear for funnels 6a, 6c, 7a and 8c, where the landscape rises steadily when approaching, and where the funnel heads occur at the highest elevation along the 500 m transect; 8b, on the other hand, is the only funnel that shows a consistent drop in elevation across the 500 m transect, but within 75 m elevation values increase again and the profile mimics that of the other funnel transects. These broad patterns are confirmed by the positive elevation gain values where the former funnels show elevation gains ranging from 7.1-11.6 m, whereas funnel 8b shows an elevation loss of 9.6 m followed by a small gain (2.9 m) nearer to the funnel head. Although the placement of funnel 8b appears to be an anomaly when comparing its landscape profile to that of the other sites, its proximity to suitable stone for walling construction (the nearby outcrop), coupled with its proximity to a nearby drainage line, may have served as the primary factors influencing site placement.

Funnels 6b, 7b and 8a also indicate a consistent rise in the landscape when approaching, however the funnel heads have been constructed in areas of lower elevation relative to the land immediately before them. Variable landscape topography is evident in the profiles themselves, primarily in the 0-75 m range where topographic undulations are visible, but it is also confirmed by their larger negative topographic values for elevation loss, maximum and average slope percentages (Fig. 6). The funnel head placement of 8a is likely linked to the crest of the nearby rocky outcrop, upon which the site has been constructed. The funnel head of 7b is concealed in the base of the small drainage channel east of the site, whereas the funnel head for 6b is only marginally lower than the elevation of the approaching landscape (by 0.5 m), so in general the site occurs on flat land with minimal elevation change across the 500 m transect (~2 m; Fig. 6).

Our line-of-sight analysis confirms that funnels 6b, 7a, 7b, and 8a are not visible when viewed from 150 m away (Figs 7-9). For funnel 6b, this includes the funnel neck, head, and part of the guiding arms, but it excludes the visible, distal portions of the arms as they open to the southwest (Fig. 7). Based on its elevation profile (Fig. 6), parts of funnel 6b are hidden due to a small topographic rise within 75 m of the funnel head, thereby obscuring the view of the funnel. Funnels 7a and 7b are not visible when approaching from the south (Fig. 8). But, instead of visibility being obscured by a topographic high, it is in fact due to a depression that occurs within 75 m of the funnel heads. For funnel 7b, this comprises the drainage channel within which the head has been placed. Finally, funnel 8a is not visible when viewed from the west, and visibility here is obscured by a small, higher-lying rocky outcrop within ~75 m of the funnel head (Figs 6 & 9).

For the remaining complete funnels, all portions of 6a, 6c and 8b are visible, corroborating the elevation profiles shown in Figure 6. Namely, that the landscape leading up to the funnel sites becomes steeper, and that all portions of the funnels occur on the gently rising upslope parts of the landscape that are visible from some distance. This is particularly the case for funnels 6a and 6c, whereas for 8b the landscape begins to drop in elevation from <150 m, so the preceding higher ground to the southeast provides a higher vantage point from which to view the landscape and funnel. That being said, the funnel does open toward a widened drainage channel, which in the past may have served as a strategic location from which to herd animals while they navigated sandy or potentially waterlogged soils. Given that herd movements may have been more restricted under these conditions, even if just for brief periods after intense seasonal thunderstorms, then funnel 'invisibility' may have been less important.

Overall, we can confirm the following trends for the newly reported Keimoes funnels:

1. Funnels are predominantly placed on gently rising slopes to take strategic advantage of high points on the landscape. These high points provide vantage points from which to spot approaching game.

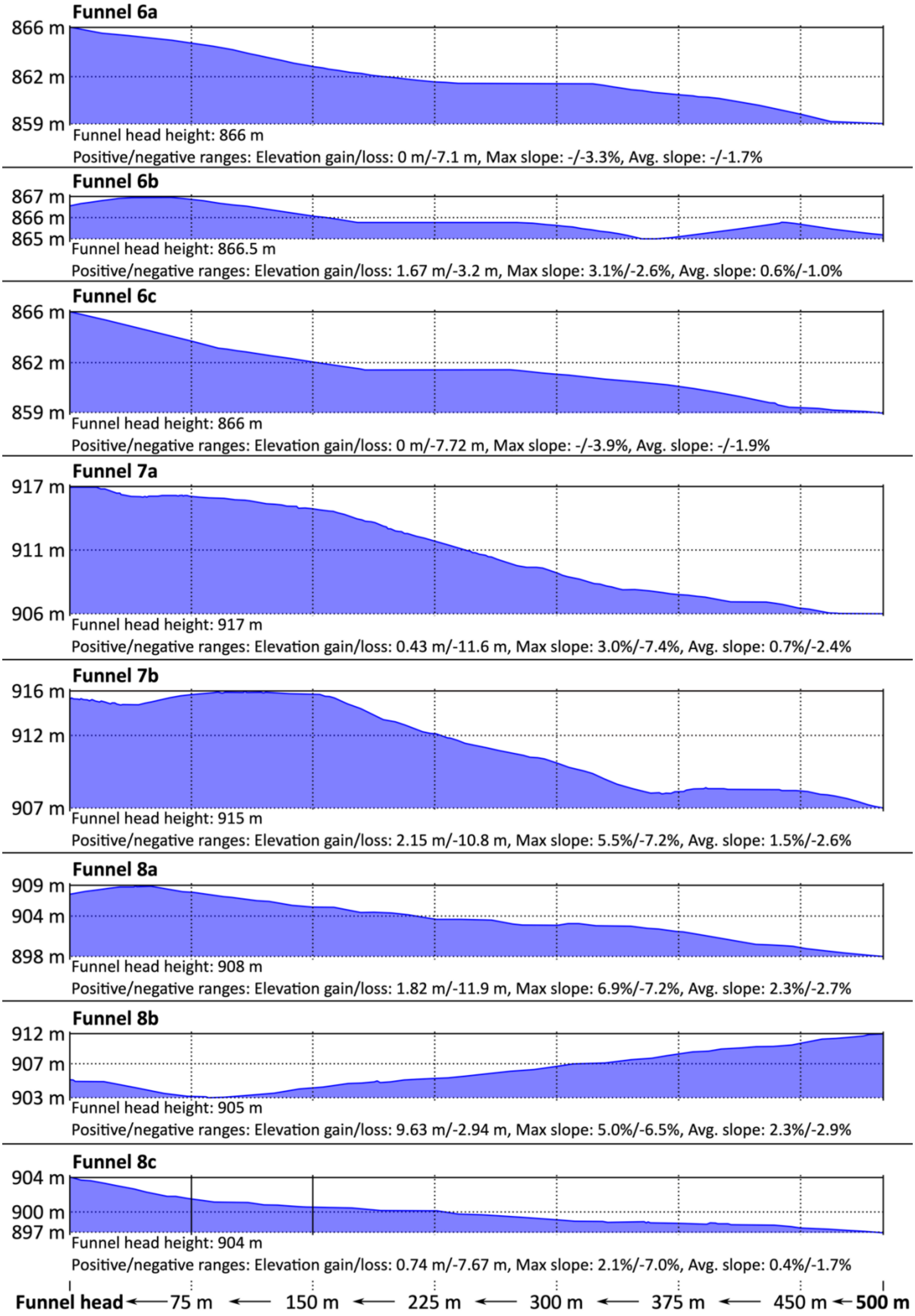

Figure 6. Funnel elevation profiles, exported and modified from Google Earth Pro, with associated topographic data. The blue profiles indicate the landscape surface when approaching funnel heads from 500 m away, with all (save for 8b) indicating the heads are uphill of the guiding arms.

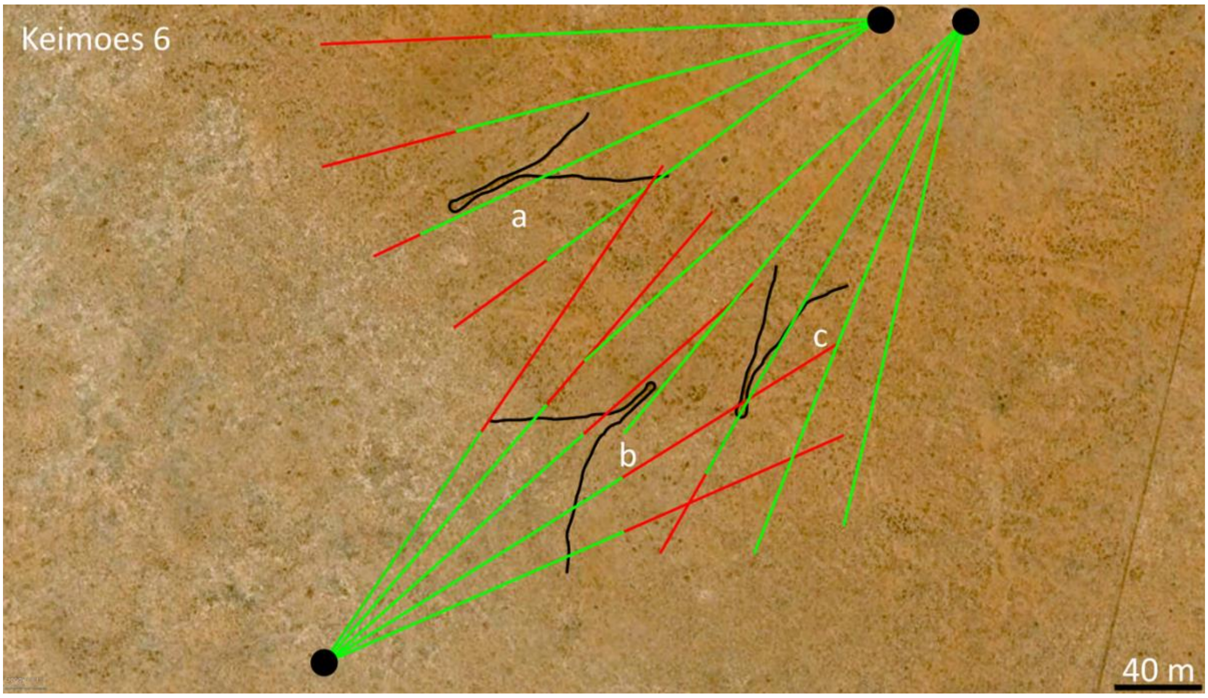

Figure 7. Line-of-sight map for the Keimoes 6 funnels when approaching from 150 m, (black circle) at an eye-height of 1 m (green=visible).

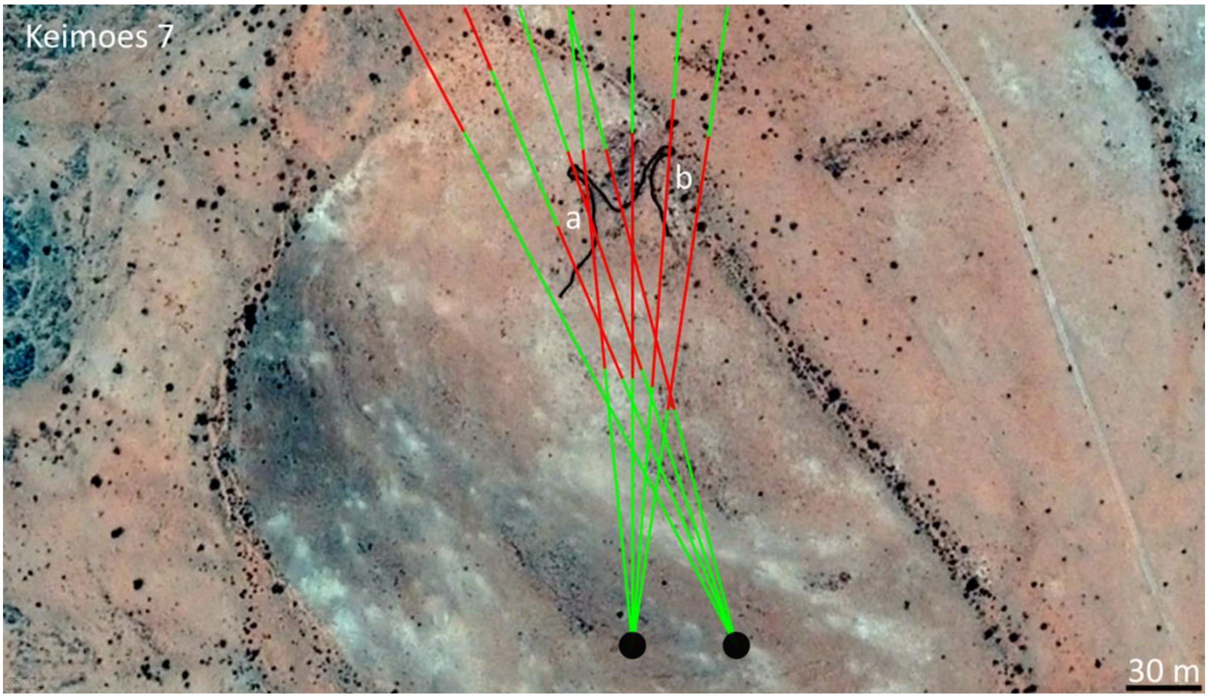

Figure 8. Keimoes 7 line-of-sight map (green=visible, black circle=150 m away).

2. Some funnels have been tactically placed on the curves of hill summits, concealing heads and necks and obscuring them from oncoming herds. For others, funnel heads and necks occur at elevations above the guiding arms, placed on undulating slopes that hide the upslope funnel apices or within topographic depressions that limit funnel visibility.
3. Funnels were constructed near to rocky outcrops from which construction material could be sourced, drainage lines, or open land between drainage lines, and near drainage divides, which suggests clear efforts to position sites in areas where animals would have been congregating or migrating, within specific parts of the surrounding landscape.

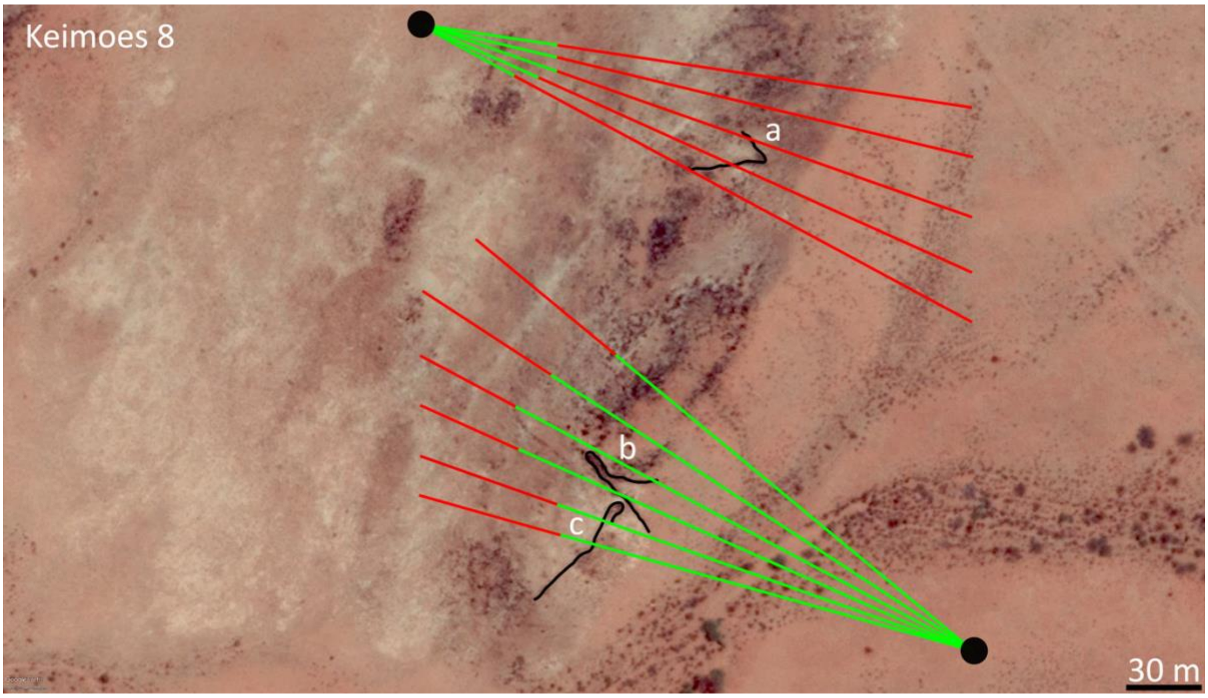

Figure 9. Line-of-sight results for the Keimoes 8 funnels (green=visible). The analysis was not run on the incomplete funnel 8c.

4. Interestingly, a trend not reported here is funnel placement near to or facing pans. None of the newly reported sites appear to be associated with pans, which differs from the observations made by Lombard et al. (2020, 2021) for the previously reported Keimoes sites (1-5).
5. Keimoes 7 and 8 were deliberately constructed within an area of greater topographic variability, given the nearby drainage lines, small rocky outcrops and nearby hills. Overall, the Keimoes landscape is flat, suggesting deliberate site placement in areas of undulating topography where herd movements may have been slowed due to sandy and/or waterlogged conditions around drainage lines, or where funnel construction was made easier given the abundance of local rocks for walling.
6. Lastly, we did not find any screens, protrusions or extensions emanating from the funnel walls of the newly discovered kite sites (as reported at Keimoes 3 and 5; Lombard et al. 2020, 2021).

4. Discussion

Our results confirm that people on the Keimoes landscape implemented standardised kite construction strategies based on funnel placement and visibility criteria, thereby confirming the strategic use of landscape elevation and microtopographic changes. Although the Keimoes funnels vary morphologically, their consistency in placement on gently rising slopes and areas with irregular topography implies that deliberate attempts were made to target higher-lying areas. Doing so would have afforded better game viewing opportunities, and the positioning of sites 6-8 relative to nearby drainage lines and divides, and open land with grazing potential, further supports their strategic placement. This is coupled with attempts to limit funnel guiding arm and head visibility, where topographical high points and undulating topography leading up to the funnels were used to obscure their view from oncoming herds, which is a consistent trend for the majority of the Keimoes kites (Lombard et al. 2020, 2021).

There are notable differences though between the previously reported kite sites 1-5 and those reported here, particularly where the new sites are not associated with pans; however, the western Keimoes landscape described here differs from that further east, having fewer pans and greater topographical variation due to the presence of hills and rocky outcrops (particularly around sites 7 and 8). As a result, it seems that funnel placement for sites 6-8 followed a different set of protocols where proximity to suitable raw materials for construction and to nearby drainage lines was prioritised, which may in turn imply that the funnels were designed to target animals moving through the landscape in search of water and good grazing, versus further east where sites 1-5 were placed nearer to areas where animals would already have been congregating to target these resources. Both the east and west Keimoes site clusters occur on landscapes with well-developed drainage lines, so although funnel placement relative to sources of standing water varies by site, the overall strategy was to place sites in areas with higher surface water potential (Lombard et al. 2020, 2021).

Despite still being uncertain as to the function of the kites, we agree that the most likely scenario is their use in communal, large-scale hunting efforts, specifically adapted to the surrounding landscape and environment. The Keimoes funnels represent permanent modifications to the landscape, where thousands of local dolerite boulders were arranged and placed strategically according to the criteria described above. Their construction would have required considerable time and effort, which likely required the cooperation and involvement of groups from across the region, and given their enduring nature they were likely managed by and passed down through multiple generations (Lombard et al. 2021). Such inter-generational custodianship would have led to the accumulation of knowledge about prey habits, seasonal movements, and abundance, which suggests that the Keimoes inhabitants would have had a deep understanding of the local landscape and how to best construct the funnels to maximise hunting proficiency (Lombard & Badenhorst 2019). The users might also have participated in client-patron relationships with nearby communities that involved procuring wild animal products through mass hunting activities. Labour relations were not uncommon between hunter-gatherers and either herder or farmer communities in several parts of Africa, including as hunters (e.g., Wright 1978; Bahuchet 1999). Further exploration of this possibility may lead to a better understanding of social relations rooted in these fixed locations.

A lack of associated surface archaeology hinders our ability to clinch the hunting argument, but data from the surrounding region further support a hunting scenario. In particular, evidence for the large-scale exploitation of small- to medium-sized bovids is found at the LSA site of Droëgrond (cal. AD 1296-1710; Smith 1995), ~90 km to the southwest, and the only other funnel reported for the region is situated at Graafwater just a few kilometres away. Based on this evidence, Beaumont et al. (1995) suggested that the arid Nama Karoo landscape likely drove a unique hunting strategy particularly adapted to this region of southern Africa – not too dissimilar from strategies employed in the arid landscapes of northern Africa and the Levant, for gazelle and Barbary sheep. If we consider some of the other trends in funnel construction and placement, their use in hunting appears even more probable: one, their placement along proposed migration/movement routes (as documented at the Negev kites; Bar-Oz et al. 2011), with discussions on springbok hunting by Lombard and Badenhorst (2019) confirming ethnohistoric accounts of large-scale springbok migrations throughout the region, coupled with strategic seasonal hunting by local San groups; two, funnel placement near water sources and open plains with grazing potential, which has already been reported for all the Keimoes funnels (Lombard et al. 2020, 2021, and here); three, rock art nearby that depicts hunting scenes (Crassard et al. 2015); four, associated mass fauna (Bar-Oz et al. 2011); and five, lithics that would imply hunting, killing and butchery (e.g., points, blades, arrowheads; Helms & Betts 1987; Hadas 2011). Currently, we lack evidence for indicators three, four and five, but Hollmann and Lombard (2020) do report evidence of petroglyphs depicting giraffes, elephants, lizards and ostriches near Keimoes 3, which confirm use of the landscape by hunter-gatherer groups at some point in time, although we cannot be sure the art is associated with the funnels or whether it was made during the same period; hunting scenes have not been identified in the vicinity. Finding fauna and associated hunting implements would be a significant step towards resolving kite functionality, which would require future surveys and excavations at multiple funnels. It is also possible that animals were removed from the funnels and butchered elsewhere, so future investigations should prioritise the assessment of all archaeological signatures across the broader landscape.

5. Conclusion

Our research provides details for three new kite sites in the broader Keimoes region, and we continue to learn about the strategies that were used in site placement to maximise resource acquisition efforts in a challenging landscape. There is potential in the future to investigate aspects of group contact and interaction, because the Keimoes landscape has a complex social history, and the kites themselves imply a level of landscape custodianship and successive generations of use or possibly ownership. By prioritising the investigation of material culture associated with these structures, if recoverable, we may be able to explore group identities and potentially establish who was responsible for their creation, because their use and management may very well have included input from multiple groups not associated with their establishment. Differentiating herder and hunter-gatherer identities across the region may be possible if there are observable differences in lithic techno-typological frequencies and ceramic and bead production traditions, between sites, coupled with the presence of domesticated livestock. For example, Beaumont et al. (1995) and Parsons (2007) have explored two distinct LSA industries in the Northern Cape, the Swartkop and Doornfontein, which are considered hunter-gatherer- and herder-produced, respectively, with each having diagnostic markers in formal stone tool compositions, domestic livestock remains, ceramic tempering and style, and settlement patterns. Furthermore, rock art has been used to differentiate forager from herder traces (Smith & Ouzman 2004). Whether this is possible in relation to the kite sites must be assessed, and how to assess whether these cultural remains are chronologically related to the structures requires considerable thought. Such an approach also relies on colonial identity constructions of groups that elsewhere have been noted as mutable (e.g., Barnard 1992; Challis 2018). Nevertheless, questioning such identities will also allow us to hypothesise about social cohesion and group cooperation on the Keimoes landscape. The very nature of the region, with its dry conditions and seasonal abundance of resources, perhaps dictated the need for local populations to band together during times of surplus to maximise hunting and resource acquisition efforts. Once we can identify cultural markers, we should be able to develop a more holistic understanding of both the landscape and the adaptive strategies that groups employed within these particular settings. Such questions are not unique. They are being asked elsewhere in southern Africa in regions with complex social histories, for example around the Seekoei River (Sampson & Neville 2018) and in the middle Limpopo Valley (e.g., Forssman 2020). The Keimoes landscape, with a more nuanced investigation of its surface archaeology, may therefore provide another opportunity to explore identities that, in turn, may shed greater light on site chronologies throughout the region. Future research will also prioritise more extensive aerial surveys of the surrounding region, to potentially locate more sites, and excavations will target those larger sites for which there may be greater potential for artefact preservation, which at the current stage would likely be at Keimoes 3 since it is the largest and most complex of all the funnel sites.

Acknowledgements

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A PRELIMINARY REPORT OF THE EXCAVATION AT SPITZKLOOF D ROCKSHELTER, NAMAQUALAND, SOUTH AFRICA

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ABSTRACT

This paper describes the first excavations of Spitzkloof D rockshelter located in the semi-arid desert of northern Namaqualand, South Africa. The site is in a dry river valley 30 km south of the Orange River, which currently acts as a lifeline for pastoralists with mixed sheep and goat herds. A surface survey of the site revealed pottery, lithics, domesticate remains, ostrich eggshell (OES) fragments and jewellery, glass beads and iron fragments. The stratigraphy is complex reflecting multiple occupations with six layers consisting of large hearths, ash deposits, and multiple pits, some with potential votive (faunal) offerings in their base. Faunal analysis reveals a broad subsistence strategy consisting of low-intensity sheep-keeping combined with the hunting of wild species found on the landscape today. The presence of *Equus zebra*, a locally extinct water obligate species, suggests occupation during a climatic period that was more humid than today. Radiocarbon dates from the upper layers confirm a Little Ice Age occupation between AD 1667-1936, when the region was cooler and wetter, and a peak in radiocarbon dates indicates a population pulse in the region. Glass trade beads, iron implements, OES beads, as well as fish remains and a limpet shell, potentially indicate that the people occupying Spitzkloof D were part of an extensive trade/interaction network. Future analysis will include increasing sample sizes through continued excavation, detailed lithic analysis, and further radiocarbon dating.

Keywords: Namaqualand, Later Stone Age, Little Ice Age, interaction, hunter-herders

1. Introduction

Recent excavations at Spitzkloof D in Namaqualand, South Africa (Fig. 1), were conducted to examine rare herder archaeological residues noted during a surface survey. Although herders have an enduring presence in the region (e.g., Lander & Russell 2018; Lombard & Badenhorst 2019; Lombard et al. 2021), and Namaqualand is a suggested western gateway for the earliest introduction of sheep to the rest of the country at 2105±65 BP (OxA-386) (Sealy & Yates 1994; Coutu et al. 2021), archaeological evidence confirming their presence in the region is rare. Only four research projects have been conducted in Namaqualand so far (Webley 1992; Dewar 2008; Orton 2012; Steele et al. 2016; Dewar & Stewart 2022) while the Archaeology Contracts Office (ACO) has conducted salvage excavations at numerous sites, primarily in the coastal mining areas of the region (Halkett & Hart 1997; Halkett 2001; Orton & Halkett 2006; Halkett & Dewar 2007). To date, there have only been a handful of sites containing domesticate remains, with Jakkalsberg and Spoegrivier Cave providing the largest samples (e.g., Webley 1992; Brink & Webley 1996; Webley 2002). The excavation and analysis of Spitzkloof D rockshelter contributes to this record by offering new data to a region with large temporal and spatial gaps as well as situating its significance within the broader context of Namaqualand archaeology.

2. Environmental background of Namaqualand

Namaqualand falls within the winter rainfall zone (WRZ) of western southern Africa, which stretches from southwestern Namibia to Cape Agulhas and extends inland to the western margin of the Great

Escarpment (Chase & Meadows 2007). The Namaqualand coastal desert receives >66% of its precipitation during the austral winter months with an average annual rainfall of 150 mm, ranging from ~50 mm in the north and up to ~300 mm in the south (Cowling et al. 1999; Chase & Meadows 2007; MacKellar et al. 2007). Namaqualand's average annual temperature is 17°C but there are marked seasonal and diurnal extremes ranging from −6°C to 35°C (Cowling et al. 1999; Dewar 2008).

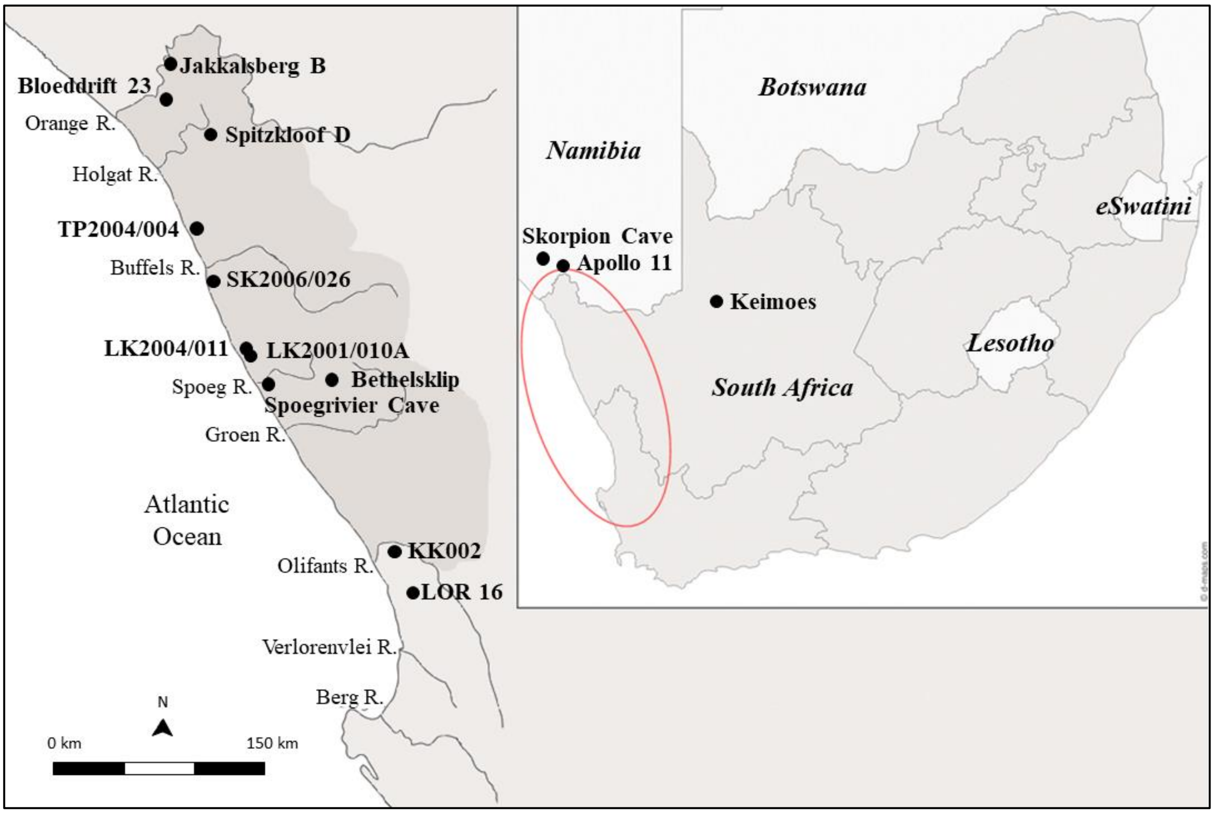

Figure 1. Map of southern Africa (inset), with the red oval indicating where the enlarged portion of the map is focused. This enlarged area shows Namaqualand (darker shade) and the approximate location of sites mentioned in the text.

Namaqualand (Fig. 1) is bounded by the only flowing rivers in the region, the Orange-Gariep River in the north and the Olifants River to the south. Although there are six perennial rivers in the region, they are typically dry throughout the year leaving around 200 km in between with no continuous/reliable water source. Coastal fogs contribute much needed precipitation, but local flora and fauna consist of arid adapted, non-obligate water drinking, species (Rutherford et al. 2006; Dewar 2008). The vegetation is predominated by dwarf leaf-succulent shrubs and classified within the Namaqualand Coastal Duneveld floral unit of the Succulent Karoo Biome (Rutherford et al. 2006). Members of the family Asteraceae and Aizoaceae are particularly prominent, as are Euphorbiaceae. The dominant vegetation type is Strandveld, which includes many low succulents predominated by Mesembryanthemacae. Although trees are rare, they can be found in the dry riverbeds and include *Vachellia karroo* (*Acacia karroo*) and *Rhus viminalis* (Acocks 1979). The wild fauna of archaeological interest consists of ostrich (*Struthio camelus*), tortoises (*Chersina angulate* and *Psammobates tentorius*) and small to medium/large ungulates, including steenbok (*Raphicerus campestris*), klipspringer (*Oreotragus oreotragus*), grey duiker (*Sylvicapra grimmia*), springbok (*Antidorcas marsupialis*), and gemsbok (*Oryx gazella*) (Dewar, 2008). Domesticate fauna in the region today includes sheep (*Ovis aries*), goats (*Capra sp.*), cattle (*Bos taurus*), donkeys (*Equus asinus*), and dogs (*Canis lupus familiaris*).

3. Location and excavation

Spitzkloof D rockshelter is in the Spitzkloof River valley ~40 km east from the Atlantic Ocean and ~30 km south of the Orange River (Fig. 1). Spitzkloof D (28°51'47.40" S, 17° 4'39.16" E) is ~250 m northeast from the shelters Spitzkloof A and B, which contain archaeological materials dating to the

Middle and Later Stone Ages (Dewar & Stewart 2012, 2016a, b; Dewar et al. 2023) and are eroded from a folded outcrop of quartzite from the Stinkfontein subgroup (Frimmel 2003). About 4 m in front of Spitzkloof D, and ~3 m below the shelter's mouth, is a dry tributary of the Holgat River (Fig. 2).

Figure 2. Photograph facing northeast of Spitzkloof D with the dry tributary of the Holgat River in the foreground (scale bar=1 m).

The drip-line of Spitzkloof D is 8 m long and the shelter is 5 m deep. During the initial surface survey conducted in 2017, 457 artefacts were recorded and mapped over 7 m^2 of the shelter floor. These surface finds included potsherds, lithics, ostrich eggshell (OES) beads, as well as both wild and domesticate faunal remains. These initial findings suggested that Spitzkloof D was a herder site and thus future excavations were planned.

Excavation began in July 2019 by establishing a 4 m^2 grid in an 'L' shape (Fig. 3). The four squares were excavated following the single context recording system (Museum of London Archaeology Service 1994), where context (stratigraphic unit) changes were based on colour, texture, and inclusions, while 3 cm spits were used for thicker contexts. Each square or excavation unit had its own context number (Table 1), where excavation unit H10 contained contexts beginning with 10xx, excavation unit H11 contained contexts beginning with 11xx, H12 contained contexts beginning with 12xx, and G12 contained contexts beginning with 13xx. Furthermore, to ensure that context numbers never overlapped, they started in the thousands. Sediment volume was measured using black 10 L buckets to the nearest 10% of a bucket. Sediments were sieved through 1.5 mm mesh to collect small artefacts. The majority of the archaeological material was sorted on-site and the rest was sorted with the help of Dolores Jacobs in the Department of Archaeology at the University of Cape Town. The deepest excavation unit, G12, was excavated to 38 cm without reaching bedrock. The following is a description of the stratigraphic sequence.

Layer 1

This layer consists of one context of surface material with an average depth across the site of 9.5 cm (Table 1). This red brown sandy silt layer with small angular inclusions consisted primarily of windblown sand, plant material, and sheep dung. There is evidence for one major rockfall event partially impacting excavation unit H12 (Fig. 3). In excavation unit H10, layer 1 contains a large modern hearth with remnants of ash and charcoal (hearth 1) in its western side. In H11, this layer consists of red gritty sand with botanical remains, roof spall inclusions, and loose ashy sediment. Excavation unit H12 also contains red sand, but with charcoal flecks likely blown over from hearth 1. In excavation unit G12 there are also old newspaper fragments. Overall, pottery, OES fragments and beads, four beads (three made of glass and one made of a currently unknown material), and faunal remains were noted in this layer.

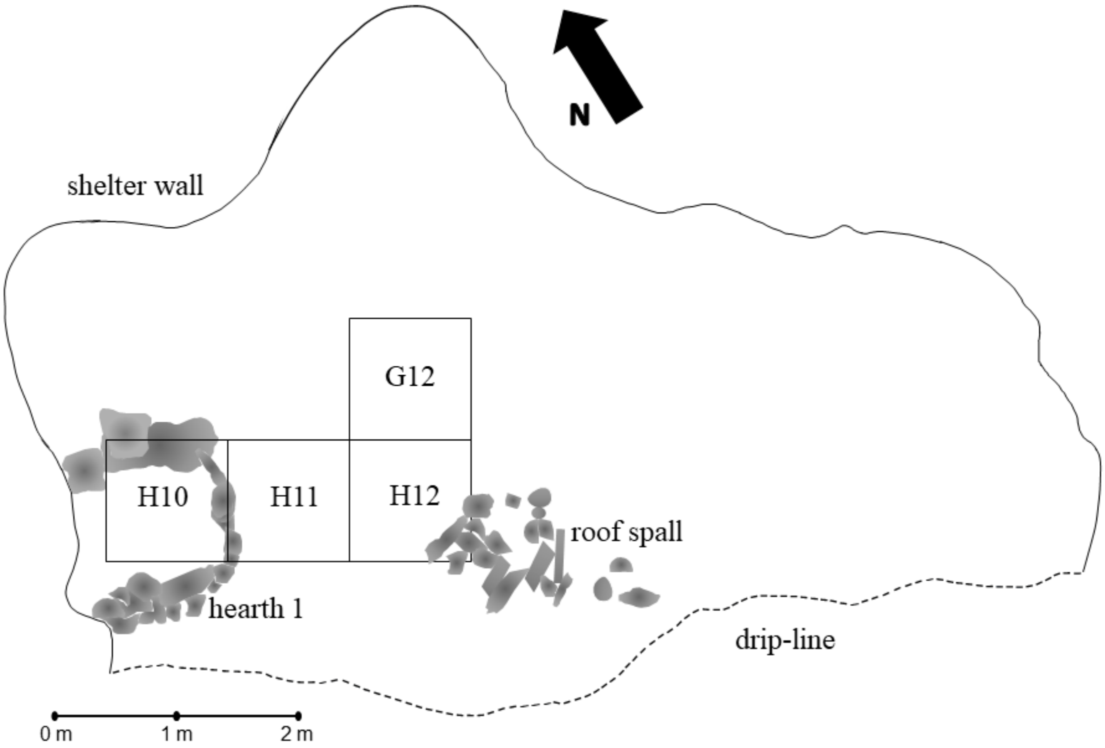

Figure 3. Site plan of Spitzkloof D showing the location of the excavation grid and surface features.

Table 1. Excavated contexts from Spitzkloof D and their associated Munsell colours.

Layer	Contexts excavated
1	1 (7.5YR 4/6, 7.5YR 4/4)
2	1000, 1001, 1003, 1005 (7.5YR 3/4, 7.5YR 5/2), 1100, 1102 (7.5YR 5/2, 7.5YR 3/4), 1200 (7.5YR 4/3, 7.5YR 4/2), 1300, 1304, 1340 (7.5YR 3/1, 7.5YR 3/3, 7.5YR 4/2, 7.5YR 4/3, 7.5YR 5/2, 7.5YR 7/1)
3	1302, 1303, 1305, 1306, 1309, 1318, 1319, 1320, 1321, 1322, 1333, 1341, 1342, 1343, 1350, 1360 (7.5YR 6/2, 7.5YR 7/1, 7.5YR 7/2, 7.5YR 8/2, 7.5YR 4/2, 7.5YR 4/2, 7.5YR 4/3, 7.5YR 5/3, 10YR 2/1)
4	1307, 1308, 1325, 1326, 1327, 1330 (7.5YR 4/2, 7.5YR 4/3, 7.5YR 5/2, 7.5YR 4/6, 7.5YR 8/1, 7.5YR 7/2)
5	1336, 1337, 1338, 1339 (7.5YR 3/2, 7.5YR 3/3, 7.5YR 4/3)
6	1006, 1103, 1201, 1323 (10YR 4/3, 7.5YR 4/2, 7.5YR 5/2)

Rodent burrow(s)

There is extensive burrowing below the surface material in excavation units H10, H11, and G12. In excavation unit H10 the burrow underlies hearth 1 in the NE and consists of grey ash very rich in plant material and bone. This burrow continues into the NW quad of H11. There is also a large rodent burrow (possible continuation of the burrow in excavation unit H10 and H11) located in the NE and NW sections of G12 that encompasses an area from just below layer 1 and extending into unexcavated sediment along the east wall. In G12, the burrow consists of grey ash with black charcoal flecks and contains angulate tortoise bone and OES beads. Although faunal remains and cultural material were found throughout the burrow, sieved, and sorted, it likely contains a mix of material from different time periods that was not analysed any further. Notable finds in this layer are two iron spears/knives (lying flat at the interface of layer 1 and the burrow) as well as other pieces of unidentifiable iron.

Layer 2

This layer begins directly under the burrow in the northern and eastern sections of G12, in the NE quad of H10, and the NW quad of H11 (Table 1). In excavation unit H12 this layer directly underlies layer 1. In excavation unit H10, this layer includes hearth 2, present everywhere in the excavation unit except for the NW quad and 5 cm in from the west side of the NE quad. Charcoal was collected from hearth 2 for radiocarbon dating. Immediately below this hearth is a charcoal spit containing very light grey ash with some bone and OES fragments. This excavation unit also has a second small hearth feature (hearth 3) shaped like a small, rounded bowl (10x10 cm) with heat degraded sandstone rocks at the southern edge.

In excavation unit H11, layer 2 is quite homogeneous consisting of two contexts (Table 1). The first context lies immediately below the rodent burrow in the NW and below layer 1 in the rest of the excavation unit. At its greatest depth, this layer extends down 12 cm along the eastern side of the northern wall. It consists of fine brown ashy deposits with very little anthropogenic material and likely corresponds to the ash layer from hearth 2 in H10. This context also contains one bead made of unknown material. The second context in this excavation unit consists of red fine sandy silt with a few small inclusions and very few artefacts.

In H12 there is only one context in layer 2 (Table 1). The upper 9 cm consisted of ashy grey silt containing small bovid remains, OES beads, and lithics. The ash in this context is likely from hearth 2. There is also a line of rocks that cuts through the NE quad in this context that appears purposefully built to perhaps act as a seating area. The lower 6 cm of this context contains loose silty sand with small rock inclusions, OES beads, and a large cluster of bones in the NE and NW.

Layer 3

This layer is found exclusively in excavation unit G12, which has the most complex stratigraphy (Fig. 4), and it consists of an infill of the most recent large cut directly under the burrow in G12. The infill material consists of numerous contexts (Table 1) and all were laid down before the burrow was created. The sediment in this layer is remarkably variable, ranging from light pinky grey to black, with some unresolved cuts and fills due to rodent burrowing activity (Fig. 4; Table 1) that made it difficult to follow during excavation. There are at least five distinct pits dug and purposely infilled with ash, charcoal, and bone. Further complicating the stratigraphy is that each pit, except for the one on the far NE corner of the excavation unit (1309), is cut into by another. The oldest pit, context 1309, contains potential votive (faunal) offerings in its base but they have yet to be excavated. One charcoal sample from this excavation unit in context 1302 was submitted for radiocarbon analysis.

Layer 4

This layer consists of four contexts (Table 1) which are truncated by layer 3 (Fig. 4). Layer 4's eastern edge cuts into layer 5 (not shown in Fig. 4) and it is overlain by the burrow. This layer is another large purposely infilled pit and consists of ashy sand (10YR 2/1), brown silty sand, many small gypsum inclusions, and mottled pinky grey ash (Table 1) containing faunal bones (mostly tortoise), charcoal, and OES. A bone sample was collected for radiocarbon dating from context 1327 in 2022 with results pending.

Layer 5

This layer contains four contexts from excavation unit G12 that have been cut on their western side by layer 4 (Table 1). This layer consists of dark brown to burnt orange silty sediment (Table 1), with small rock inclusions, and it contains no cultural material.

Layer 6

This is the oldest layer and contains four contexts (Table 1). In H10, the sediment consists of brown and tan sand amongst degraded rocks. There are considerably fewer artefacts and mostly tortoise in the faunal assemblage. In excavation unit H11, the sediment consists of silty red/brown sediment with angular roof spall inclusions and fine roots throughout, and it contains considerably fewer artefacts. The faunal assemblage consists of mostly medium/large sized bovids. In excavation unit H12, this layer consists of loose brown sediment with many large (up to 30 cm long) roof spall inclusions. The rocks in this context become white and friable upon trowelling and are easily broken, which may be a sign that the rocks were exposed to heat. Again, there are very few artefacts, and the faunal assemblage consists of two small/medium bovid ribs. In G12, this layer consists of fine light brown silty sediment.

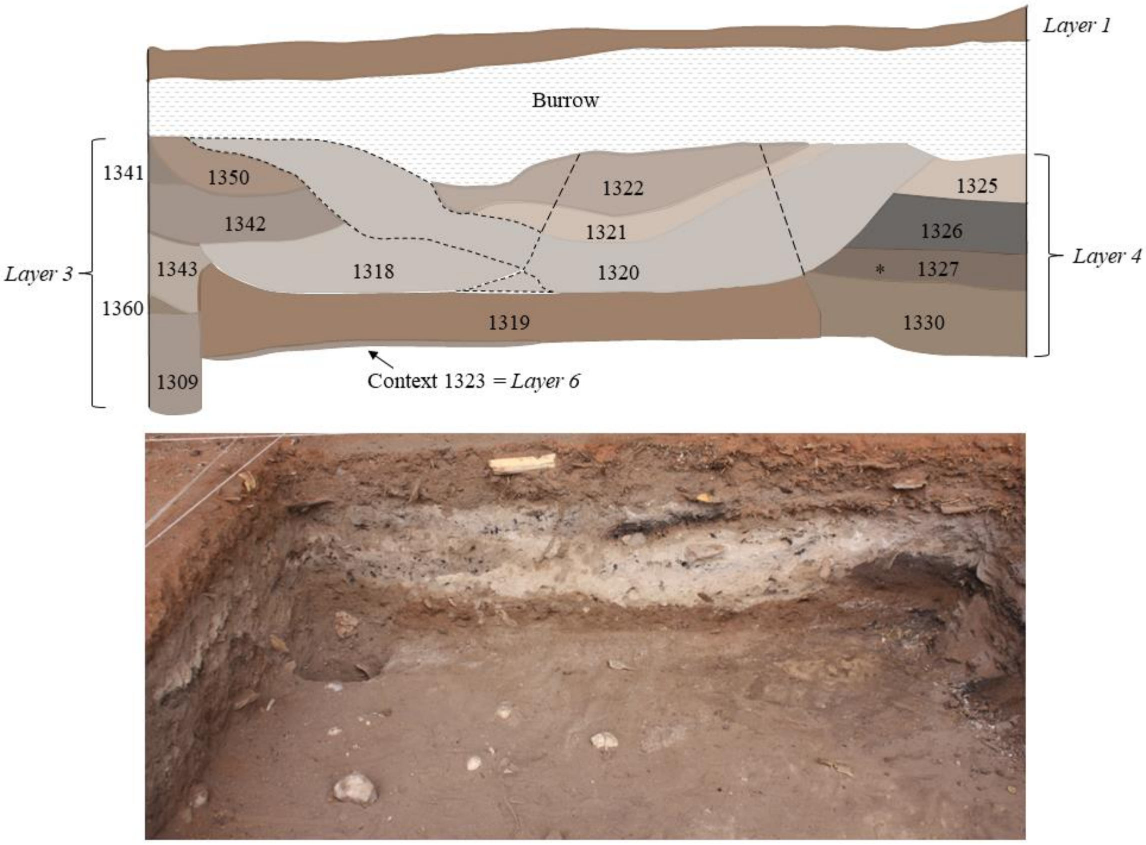

Figure 4. Section drawing (top) and photograph (bottom) of excavation unit G12 north wall. Colours correspond to their Munsell colour recorded during excavation (*=location of radiocarbon dating sample taken in 2022). Dashed lines refer to contexts that are not fully resolved due to rodent activity.

4. Methods and analyses

All radiocarbon dates were measured at the University of Oxford's Radiocarbon Accelerator Laboratory. All dates were calibrated using OxCal 4.4 (Bronk Ramsey 2009) and the ShCal20 curve (Hogg et al. 2020).

Faunal remains were identified by comparison with specimens housed in the reference collection at the Faunal Lab at the University of Cape Town. Each fragment was identified to its lowest possible taxon with unidentified elements contributing to the total number of specimens (NSP). The element, side, end, proportion, age at death, and sex were identified for each bone, when possible. The results are presented as number of identified specimens (NISP) while the minimum number of individuals (MNI) was calculated using the most common element present accounting for size and age (juvenile vs. adult). Anthropogenic (e.g., cutmarks), geogenic (e.g., weathering), and biogenic (e.g., root etching) modifications were noted, when present (Behrensmeyer 1978; Johnson 1985; Lyman 1994).

Bovid size classifications follow Brain's (1981) and Klein's (1976) categorisations, where small bovids (Bov size class I) are 4.5-23 kg, small/medium bovids (Bov size class II) are 23-84 kg, medium/large bovids (Bov size class III) are 85-295 kg, and large bovids (Bov size class IV) are 296-900 kg. Faunal material that could be identified as potentially mammal was categorised following the same live weight categorisation as for the bovids above. Small mammals include the species that are <4.5 kg (hyrax and hare), while micromammals consist primarily of vlei rats and shrews. The fragmentation ratio of the total faunal assemblage was calculated using the total number of specimens in the faunal assemblage divided by its total weight (NSP/g). Observations on the faunal material from the rodent burrow(s) are not reported here.

The diversity of the species is assessed using species richness, recorded as the number of taxa (NTAXA), while evenness, or diet breadth, is recorded using the unbiased Simpson's Index (1-D',

$D' = \Sigma((ni(ni-1)/(N(N-1)))$. Accordingly, where D' refers to the probability that two individuals randomly selected from a sample will belong to the same species, and where n_i is the abundance of taxon i, and where N is the total number of individuals (species, NTAXA) (Faith & Du 2018). The unbiased Simpson's index represents the probability that two random samples will belong to the same taxon. D' values range from 1/NTAXA, when all taxa are equally abundant, to 1 when an assemblage is predominated by a single taxon. It is presented as 1-D' so as evenness increases, the value increases to 1. It is a measure of heterogeneity that is sensitive to richness, particularly rare taxa, and evenness (Lyman 2008; Faith & Du 2018; Faith & Lyman 2019). To compare the results of the diet to previously published data and to increase the sample size, the evenness of the taxa is presented by ungulate size class (1-4), small mammals, and fish based on MNI. For example, an MNI of three duiker and two springboks would contribute five individuals to the MNI category ungulate size 2. Additionally, two adult steenbok and a juvenile size one bovid would contribute three individuals to the MNI category for ungulate size 1. When categories consist of two size classes (Bov1/Bov2), each MNI category was allocated 0.5 following the method presented by Faith (2008). As NISP and MNI are both measures of taxonomic abundance that scale to each other in a predictable manner, either measure will reflect the data (Grayson 1984; Faith 2008). We used MNI due to the fragmentation of the assemblage which preferentially biases the identification of smaller species, making large animals effectively appear rare. Following Faith (2008), the comparative samples (layers) must have a total MNI of at least four individuals.

The Diet Breadth Model in Optimal Foraging Theory predicts that high evenness or diet breadth reflects a highly mobile population typically associated with reduced availability or encounter rates with high-ranking species (Kelly 2013). Low evenness, or a narrow diet, reflects high encounter rates with high-ranked species, effectively ignoring low-ranked species when encountered. This typically results in a less mobile settlement system with abundant prey.

We then use $\chi 2$ statistics to test for differences between layers based on standardised residues (less than -2 to >2). We also expect a strong negative correlation between evenness and NTAXAprey, and MNIprey. Sites with low evenness (lower mobility) should produce higher NTAXAprey and MNIprey, as the site is occupied for a longer period. We test this assertion using Pearson's correlation coefficient.

For the non-ornamental OES fragments, approximate number of eggs (ANE) was recorded according to Collins & Steele (2017). ANE was calculated to provide an indication of how many ostrich eggs accumulated within a specific archaeological layer by dividing the weight of OES fragments by the 'typical' weight of an empty ostrich eggshell (Kandel 2004; Dewar 2008; Orton 2008). OES beads were measured with digital callipers recording bead diameter, aperture, and thickness, wherever possible. To obtain bead diameter, multiple measurements were taken around the perimeter of the bead. OES bead preforms were assigned a manufacturing stage, following Kandel & Conard's (2005) and Orton's (2008) classification stages, as they provide different information on the production phases. Glass bead sizes are measured in the same manner as OES beads.

Preliminary analysis has divided the stone assemblage into either formal tools or waste. The latter includes pieces which lack deliberate retouch, as well as the class of trimmed flakes which show signs of random utilisation rather than secondary retouch. Formal tools have been defined as pieces which have been deliberately modified to a standardised form by secondary retouch. Lithic analysis is ongoing, and only the assemblage from the surface of layer 1 has been analysed (by Kyra Pazan) and is included in this paper.

Other material culture, such as the glass trade beads and the iron spears/knives, the latter of which appear to have been manufactured using folding and cold working, are currently awaiting full analysis by specialists.

5. Results

Chronology and settlement

Radiocarbon dates from charcoal features (Table 2) in layers 2 and 3 are younger than expected but older than the artefacts on the surface (e.g., the newspaper fragment). They both reflect a late Little Ice Age (LIA) period (AD 1300-1850) occupation when Namaqualand was cooler and wetter than today (Dewar 2008; Dewar & Orton 2013; Dewar & Stewart 2016b).

Table 2. Radiocarbon dates obtained on charcoal from Spitzkloof D.

Layer	Excavation unit	Spit	Context	Lab number	Material	Uncalibrated years bp	Calibrated age (95.4% prob.)
2	H10	1	1000	OxA-41064	Charcoal	200±16	AD 1667-1936
3	G12	3	1302	OxA-41063	Charcoal	176±16	AD 1675-?

Faunal remains

Table 3 shows the NISP and MNI of the faunal remains. The assemblage NSP consists of 9369 bone fragments weighing 9.44 kg. Of those, 4979 or 53.1% were identified to species or class size. This assemblage is diverse and has relatively high faunal identification but is still fragmented (NSP/g=9.9). Overall, the assemblage is largely predominated by tortoises, micromammals, and bovids. Based on the assemblage and site location, the small bovids are likely steenbok, but some may also be klipspringer. Fragmentary post cranial remains of small/medium bovids are likely domesticated sheep but could also be grey duiker or springbok, medium/large bovids are likely gemsbok, while large bovids are probably eland (*Taurotragus oryx*) or domestic cattle. Other species identified at the site include baboon (*Papio ursinus*), mountain zebra (*Equus zebra*), hyrax (*Procavia capensis*), porcupine (*Hystrix africaeaustralis*) small carnivores, snakes, a bird, and a fish. The eland and mountain zebra are locally extinct species.

In layer 1, based on the NISP, micromammals (elephant shrew, Brants's whistling rat), and tortoises (*Chersina angulata* and *Psammobates tentorius*) are the most common, followed by steenbok and small/medium bovids including duiker and possible sheep (Table 3). In layer 2, the species list is predominated by the tortoises followed by micromammals, small bovids (klipspringer, steenbok), medium/large bovids (likely gemsbok) and small/medium bovids including duiker and sheep (distal phalanx), plus a probable sheep (two teeth and long bone epiphysis). Additionally, eland, mountain zebra, and both an adult and juvenile baboon, were identified. The most abundant species in layer 3 are tortoises, micromammals, and small mammals (hyrax) but there are also two pedal bones belonging to a mountain zebra. Interestingly, although 40 km from the Atlantic Ocean (Fig. 1), there is one fragmentary limpet shell (*Cymbula granatina*). In layer 4, tortoises and micromammals are again the most common with the addition of steenbok and mountain zebra. There are no faunal remains in layer 5, while in layer 6, the most common elements belong to the tortoises, micromammals, small carnivores (bat-eared fox), and small/medium bovids (sheep and/or springbok), but there is also one tooth belonging to a mountain zebra and a small fish vertebra.

To evaluate the hunting strategy only the anthropogenically introduced species (ungulates, tortoises, and small mammals) were used to calculate NTAXAprey, MNIprey, and unbiased Simpson's evenness index (1-D') for each layer (Table 3). Focusing on just the ungulates, all layers produced unbiased Simpson's evenness values above 0.75, indicating a relatively broad diet. People were primarily encountering size 2 and 3 ungulates with some access to size 4 eland (Table 4). Diet Breadth Theory (Kelly 2013) indicates that this is a high level of mobility (Faith & Lyman 2019). Statistically evaluating the evenness values reveals they are indeed the same ($\chi 2$=3.1, df=12, p=0.99), reflecting a consistent use of the local niche. Comparing the evenness index value against NTAXAprey and MNIprey produced very strong negative correlations (r=-0.94 and -0.83, respectively), supporting our expectations that sites with lower evenness indices would produce higher NTAXAprey and MNIprey.

When including the small species that would be added to a broadening diet (tortoises and small mammals), the evenness index values remain relatively consistent except in layers 2 and 6 which drop to 0.63 and 0.59, respectively, indicating a narrower diet or longer periods of occupation focusing on one food category – tortoises; however, the evenness values and therefore the hunting strategy, and use of the local niche, remains statistically the same ($\chi 2$=12.4, df=20, p=0.90). There is also a moderately negative correlation coefficient between evenness (ungulates 1-4, tortoise, and small mammals) and NTAXAprey and MNIprey (r=-0.74 and -0.77 respectively).

Table 3. Spitzkloof D number of identified specimens (NISP) and minimum number of individuals (MNI), listed by species in taxonomic order, where S=small, M=medium and L=large (*=where the species do not increase the MNI as they could belong to the named species in their size class).

Species	**Layer 1**		**Layer 2**		**Layer 3**		**Layer 4**		**Layer 6**	
	NISP	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**
Elephant shrew (*Elephantulus edwardii*)	1	1	1	1	-	-	-	-	-	-
Baboon (*Papio sp.*) juvenile	-	-	1	1	-	-	-	-	-	-
Baboon (*Papio sp.*) adult	1	1	2	1	-	-	-	-	-	-
Bat-eared fox (*Otocyon megalotis*)	-	-	-	-	-	-	-	-	1	1
Carnivore (jackal-sized)	1	1	1	1	-	-	-	-	-	-
Mountain zebra (*Equus zebra*)	-	-	3	1	2	1	2	1	1	1
Hyrax (*Procavia capensis*)	4	2	14	1	1	1	-	-	-	-
Sheep (*Ovis aries*)	-	-	1	1	-	-	-	-	-	-
Ovicaprid sp. (probable sheep)	2	1	3	1	-	-	-	-	-	-
Common (Grey) duiker (*Sylvicapra grimmia*)	2	1	11	1	-	-	-	-	-	-
Springbok (*Antidorcas marsupialis*)	-	-	1	1	-	-	-	-	-	-
Klipspringer (*Oreotragus oreotragus*)	-	-	5	1	-	-	-	-	-	-
Steenbok (*Raphicerus campestris*) juvenile	-	-	1	1	-	-	-	-	-	-
Steenbok (*Raphicerus campestris*) adult	5	1	11	1	-	-	3	1	-	-
Eland (*Taurotragus oryx*)	-	-	1	1	-	-	-	-	1	1
Gemsbok (*Oryx gazella*)	1	1	3	1	-	-	-	-	-	-
S bovid (Bov I)	10	*	43	*	5	1	1	*	3	1
S (Bov I) to S/M (Bov II) bovid adult	2	*	1	*	2	*	1	*	-	-
S (Bov I) to S/M (Bov II) bovid juvenile	1	1	-	-	-	-	-	-	-	-
S/M bovid (Bov II) juvenile	-	-	-	-	1	1	-	-	-	-
S/M bovid (Bov II) adult	6	*	19	*	4	1	-	-	4	1
S/M (Bov II) to M/L (Bov III) bovid juvenile	-	-	1	1	-	-	-	-	-	-
S/M (Bov II) to M/L (Bov III) bovid adult	1	*	5	*	-	-	-	-	-	-
M/L bovid (Bov III) adult	3	*	26	*	3	1	-	-	2	1
M/L bovid (Bov III) juvenile	-	-	2	1	-	-	-	-	-	-
M/L (Bov III) to L (Bov IV) bovid	-	-	5	*	-	-	-	-	-	-
L bovid (Bov IV)	-	-	1	*	-	-	-	-	-	-
Brants's whistling rat (*Parotomys brantsii*)	11	1	48	9	2	1	2	1	3	2
Cape porcupine (*Hystrix africaeaustralis*)	4	1	-	-	-	-	-	-	-	-
Micromammal	117	4	105	5	19	1	5	1	4	1
S mammal	20	*	50	1	10	*	2	1	4	1
M mammal	-	-	1	*	1	*	-	-	-	-
L mammal	4	1	6	*	5	1	2	1	2	*
S fish	-	-	-	-	-	-	-	-	1	1
M raptor	-	-	1	1	-	-	1	1	-	-
S snake	2	1	18	1	4	1	1	1	-	-
M snake	3	1	22	1	5	1	-	-	-	-
L snake	-	-	2	1	-	-	-	-	-	-
Angulate tortoise (*Chersina angulata*)	101	2	902	9	118	2	8	1	82	10
Tent tortoise (*Psammobates tentorius*)	26	1	49	1	-	-	7	1	1	1
Tortoise	88	1	2056	10	91	1	133	*	507	*
Land snail (*Trigonephrus sp*)	2	2	2	1	-	-	1	1	-	-
Granite limpet (*Cymbula granatina*)	-	-	-	-	1	1	-	-	-	-
Unidentified fragments	340	-	2560	-	324	-	273	-	893	-
NTAXAprey	**8**		**11**		**7**		**5**		**8**	
Total MNIprey	**13**		**34**		**10**		**6**		**17**	
Unbiased Simpson's evenness index (1-D') for ungulates 1-4	0.85		0.77		0.87		1.0		0.9	
Unbiased Simpson's evenness index (1-D') for ungulates 1-4, small mammals, and tortoises	0.86		0.63		0.89		0.93		0.59	

Overall, anthropogenic, biogenic, and geogenic modifications of bone are rare or absent (Table 5) with no evidence for cut marks, percussion marks, puncture marks, acid etching, or root etching.

Heat alteration is present on 51% of the faunal sample (Table 5) with bones being scorched (18.8%; superficial burning), charred (14%; blackened), and calcined (17.7%; whitened) indicating that these bones were in close contact with fire for varying lengths of time, or at variable heat (Lyman 1994). Calcined bone occurs only with anthropogenic prolonged fires under high temperatures. Scorched and charred bone can occur either in a bush fire or due to a short exposure in an anthropogenic fire (David 1990). Most bones were entirely burnt indicating that they had been defleshed when thrown into the fire, likely as food waste rather than being lost during cooking. This likely contributed to the fragmentation of the assemblage as the crystalline structure of bone is damaged when heated.

Table 4. Minimum number of individuals (MNI) of prey species per category per layer.

Category	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
Tortoise	4	20	3	2	11
Small mammal	3	2	1	1	1
Ungulate size 1	1.5	3	1	1	1
Ungulate size 2	2.5	4.5	2	0	1
Ungulate size 3	1	3.5	2	1	2
Ungulate size 4	1	1	1	1	1

Table 5. Modifications identified on bone from Spitzkloof D. Number of bones with modification/% of bones with modification based on the NISP.

Layer	NISP	Scorched	Charred	Calcine	Gnawed	Spiral fracture	Irregular fracture
1	416	7/1.7	8/1.9	25/6.0	-	4/1	3/0.7
2	3520	72/2.1	50/1.4	26/0.7	1/0.03	2/0.06	6/0.2
3	273	21/7.7	13/4.8	14/5.1	-	-	-
4	169	12/7.1	10/5.9	10/5.9	-	-	-
5	-	-	-	-	-	-	-
6	601	1/0.2	-	-	-	-	-
Layer	**NISP**	**Weathered**					
		Stage 0	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**
1	416	397/95.4	9/2.2	7/1.7	3/0.7	-	-
2	3520	3519/99.9	-	1/0.03	-	-	-
3	273	-	-	-	-	-	-
4	169	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	601	-	-	-	-	-	-

Following Behrensmeyer's (1978) six stages of weathering, most bones show no signs of weathering and the ones that do are from layer 1 and layer 2. In layer 1, nine show cracking parallel to the fibre structure (stage 1), seven show flaking along the bone edges on the outermost concentric thin layers (stage 2), and three show patches of rough, homogeneously weathered compact bone (stage 3). In layer 2, only one bone shows flaking along the bone edges on the outermost concentric thin layers (stage 2). The infrequency of weathering damage and carnivore/rodent gnawing suggest that the faunal remains were probably covered soon after deposition, preventing these taphonomic factors from drastically affecting the bone. Although, burning and fragmentation could be masking evidence for cut marks, percussion notches, and gnawing.

OES fragments

Table 6 shows the ANE per layer, calculated by dividing the weight of OES fragments per layer by the average weight of 259 g (Dewar 2008), 238±37 g (Kandel 2004), and 248.6±21.8 g (Orton 2008) of an empty OES (Collins & Steele 2017). In total, there are approximately 17 ostrich eggshells in the assemblage with the highest numbers in layer 2 and the lowest number of eggs in layer 4 (Table 6).

Table 6. OES weight and the corresponding approximate number of whole eggshells per layer.

Layer	**Weight (g)**	**Approximate number of eggshells (ANE)**		
		g/259 g (Dewar 2008)	**g/238±37 g (Kandel 2004)**	**g/248.6±21.8 g (Orton 2008)**
1	1291.21	5	4.7-6.4	4.8-5.7
2	2246.27	8.7	8.2-11.2	8.3-9.9
3	389.84	1.5	1.4-1.9	1.4-1.7
4	97.26	0.4	0.4-0.5	0.4
5	-	-	-	-
6	245.25	1	0.9-1.2	0.9-1.1
Total	**4269.83**	**16.6**	**15.6-21.2**	**15.8-18.8**

OES beads

There are 28 finished OES beads, in addition to 32 OES bead preforms (Table 7). The unbroken complete beads (n=19) have a mean external diameter of 5.98±1.90 mm while ranging from 3.68-9.69 mm, a mean aperture of 2.10±0.69 mm while ranging from 0.91-3.40 mm, and a mean thickness of 1.48±0.29 mm while ranging from 0.68-1.92 mm. The largest number of OES beads was found in excavation unit H11, whereas they were least frequent in excavation units H10 and H12. At Spitzkloof D, there is almost an equal number of preforms in relation to finished beads (Table 7). This suggests that OES beads may have been manufactured during the occupations in layer 1, 2, 3 and 6.

Table 7. Number of OES bead preforms by layer and stage of production following Kandel and Conard's (2005) and Orton's (2008) classification stages.

Layer	**Complete beads (n)**	**Broken beads (n)**	**Preforms by stage (n)**									
	11 VIIa IIb	12 VIIa VIIb	1 I -	2 - -	3 IIa Iib	4 Iia Iib	5 IIIa IIIb	6 IIIa IIIb	7 Iva Ivb	8 Iva Ivb	9 Va Vb	10 Va Vb
1	2	1	-	7	2	5	-	2	-	-	-	-
2	14	6	1	5	-	3	-	3	-	-	-	-
3	2	1	-	-	-	1	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	1	1	1	-	-	1	-	1	-	-	-	-
Total	**19**	**9**	**2**	**12**	**2**	**10**	**-**	**6**	**-**	**-**	**-**	**-**

Figure 5 and Table 8 show the relationship between OES bead diameter and aperture in each layer and they reveal two distinct bead groupings. One group contains beads less than 6 mm in diameter (group 1) with smaller apertures, and the second group contains beads ≥8 mm in diameter (group 2) with larger apertures. A Mann-Whitney Test for equal medians between the group 1 and group 2 diameters and apertures showed this difference to be significant (p[same med.] diameter=0.003 and p[same med.] aperture=0.005).

Figure 6 (and Table 8) shows the relationship between OES bead thickness and aperture for each layer. Orton (2008) found that a relationship between increasing aperture diameter and decreasing thickness is an indication of use-wear. When considering all the beads at Spitzkloof D, we do not see a statistically significant association between increasing aperture and decreasing thickness (Pearson's correlation coefficient p[uncorr]=0.43). Although, Figure 6 does suggest a possible trend if the beads from group 2 (Fig. 5) are removed (circled in Fig. 6). Removing those beads from the Pearson's correlation coefficient calculation (p[uncorr]=0.06)) gives a moderate correlation (-0.49) indicating that as aperture increases, thickness does decrease, but in a non-significant relationship (i.e., a trend instead of a statistically significant association).

Non-OES trade beads

Layers 1 and 2 contain four glass trade beads and one of unknown material (Table 9). Following Wood's (2011) glass bead size and length categories, the two beads from excavation units H10 and G12 fall into the minute size category, whereas the other two glass beads fall into the small size category. The glass beads from H12 and H11 are considered short and the beads from H10 and G12 are considered standard length (Wood 2011). Visual comparison with Kinahan's (2000) illustrated beads from the Namibian coast suggests an age of between the eighteenth and early twentieth centuries. That the beads at Spitzkloof D come from layers that date to at least AD 1667 and between AD 1667 and AD 1936 further supports this conclusion.

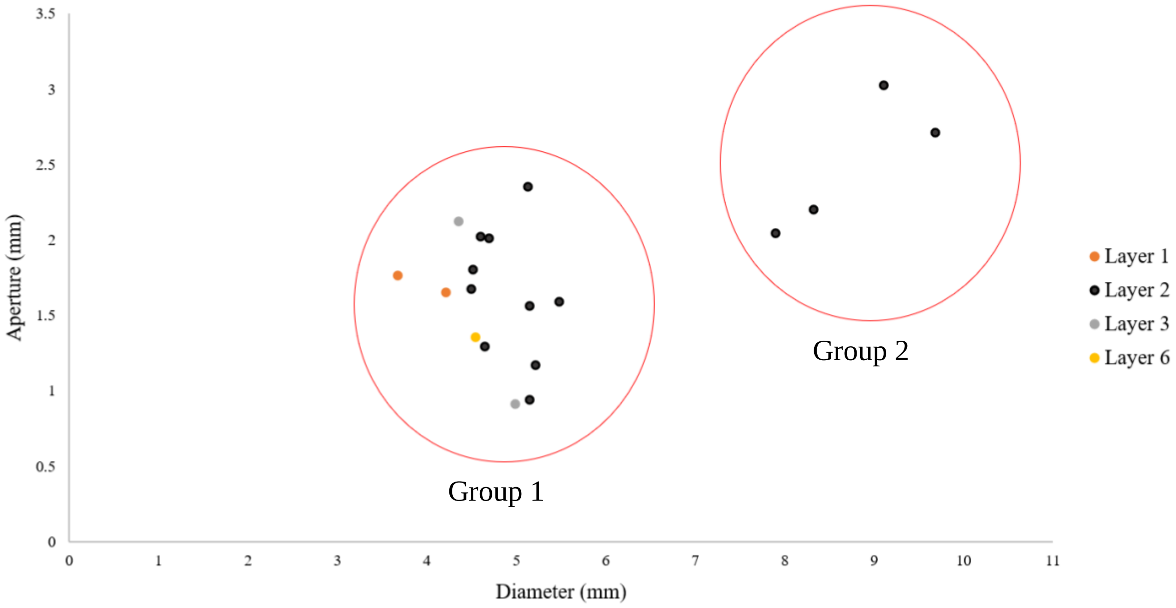

Figure 5. Scatterplot comparing OES bead diameter to aperture from Spitzkloof D by layer, where group 1 beads are <6 mm and group 2 beads are ≥8 mm.

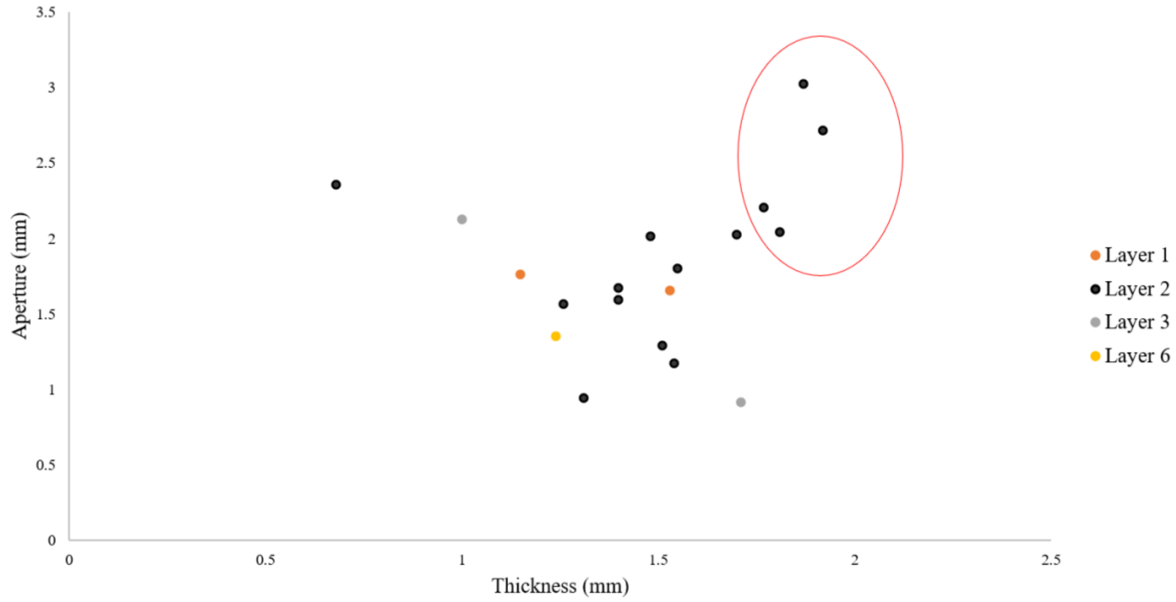

Figure 6. Scatterplot comparing OES bead thickness to aperture from Spitzkloof D by layer (group 2 beads encircled in red).

Pottery

Ceramics were found in all four of the excavated units, and in layers 1, 2, and 6. There are a total of 68 potsherds weighing 192 g, including one lug and two rims, but with no decoration evident on any of the sherds. The temper for all sherds consists of fine-grained sand, with 62 black, six red, and three sherds having an outer black with red inner colour. Most sherds show evidence of partial oxidation and/or burning that suggests the vessels were used for cooking in a hearth. The average sherd thickness is 6.18±1.26 mm, ranging from 3.07-11.88 mm. Layer 1 contained 12 sherds (17.6%), layer 2 contained 55 (80.9%), and layer 6 contained one sherd (1.5%). Overall, the sherds are friable and small with 91.4% weighing less than 10 g (the single largest sherd weighed 13.5 g).

Table 8. Stratigraphic layer, diameter, aperture, and thickness of OES beads from Spitzkloof D.

Layer	Diameter (mm)	Aperture (mm)	Thickness (mm)
1	4.22	1.65	1.53
1	3.68	1.76	1.15
2	5.15	1.56	1.26
2	5.48	1.59	1.40
2	5.22	1.17	1.54
2	4.65	1.29	1.51
2	9.69	2.71	1.92
2	5.13	2.35	0.68
2	4.52	1.80	1.55
2	5.15	0.94	1.31
2	4.60	2.02	1.70
2	4.70	2.01	1.48
2	4.50	1.67	1.40
2	9.11	3.02	1.87
2	8.33	2.20	1.77
2	7.90	2.04	1.81
3	4.36	2.12	1.00
3	4.99	0.91	1.71
6	4.55	1.35	1.24

Table 9. Stratigraphic layer, outside diameter, aperture, thickness, translucency, and colour of non-OES beads from Spitzkloof D.

Layer (excavation unit)	Material	Diameter (mm)	Aperture (mm)	Thickness (mm)	Translucency	Colour
1 (H11)	Unknown	2.65	0.95	2.32	N/A	N/A
1 (G12)	Glass	2.43	0.74	2.14	Opaque	Brown
1 (H10)	Glass	2.48	0.76	2.44	Opaque	Yellow
1 (H12)	Glass	3.24	1.24	1.61	Opaque	Very dark blue/black on brown
2 (H11)	Glass	2.73	0.81	1.80	Opaque	Brown

Lithics

Lithic analysis is ongoing, so the data presented here provide an initial characterisation of the assemblage on the surface of layer 1. Table 10 summarises the raw material trends from the surface of layer 1. Milky quartz was the dominant raw material compromising 69% of the assemblage, followed by quartzite at 20.4%. Other materials including clear quartz (4.3%), silcrete (2.2 %), and sandstone (1.1%) are far less frequent. Flakes (Table 11) are the most common lithic class overall, comprising 58.2% (n=54) of the stone artefacts found on the surface of layer 1. There is also one bladelet and two blades in the assemblage. Overall, the surface assemblage looks like a late Holocene ad hoc quartz flake industry, a common feature on the west coast during the last 2000 years (Orton 2012).

Table 10. Spitzkloof D lithic raw material trends for the surface of layer 1.

Raw material	Number of pieces (n)	Percentage (%)
Milky quartz	64	68.8
Quartzite	19	20.4
Clear quartz	4	4.3
Sandstone	1	1.1
Silcrete	2	2.2
Other	3	3.2
Total	**93**	**100**

6. Discussion

The complex stratigraphy and range of cultural remains in the Spitzkloof D deposit confirm repeated occupation of the site into the historic period, which is not unexpected as modern herders use the valley today. The radiocarbon dates from the upper layers (Table 2) suggest an occupation during the end of the LIA, a cool and wet period with a peak in radiocarbon dates interpreted as a population boom in

Namaqualand (Dewar 2008; Dewar & Orton 2013). Sheep and probable sheep, iron, glass beads, ad hoc lithics, and pottery suggest that the entire excavated deposit likely dates to within the last 2000 years (Sealy & Yates 1994; Dewar 2008; Orton 2012; Coutu et al. 2021).

Table 11. Spitzkloof D lithic class distributions for the surface of layer 1.

Lithic artefact class	Material	Number (n)	Percentage (%)
Broken flake	Milky quartz	15	16.2
	Quartzite	5	5.3
	Clear quartz	3	3.2
	Other	2	2.2
	Sandstone	1	1.1
	Total	26	28.0
Whole flake	Milky quartz	16	17.3
	Quartzite	5	5.4
	Silcrete	2	2.2
	Clear quartz	1	1.1
	Total	24	26.0
Flaked piece	Quartzite	3	3.2
	Milky quartz	1	1.1
	Total	4	4.3
Core	Milky quartz	8	8.6
	Quartzite	2	2.2
	Total	10	10.8
Core reduced piece	Milky quartz	2	2.2
	Total	2	2.2
Core on flake	Milky quartz	2	2.1
	Quartzite	1	1.1
	Total	3	3.2
Bladelet	Milky quartz	1	1.1
	Total	1	1.1
Broken blade	Milky quartz	1	1.1
	Total	1	1.1
Blade	Quartzite	1	1.1
	Total	1	1.1
Shatter	Milky quartz	14	15.0
	Quartzite	2	2.1
	Total	16	17.1
Unknown	Milky quartz	4	4.0
	Other	1	1.1
	Total	5	5.1
Total		**93**	**100**

The species identified at the site are typical of the region today except for mountain zebra and eland, which are locally extinct but present on the Namibian side of the Orange River. The mountain zebra is a water obligate species, suggesting the region was more humid and that it supported grasses when occupied. While eland has not been positively identified in this valley before, mountain zebras were present at the end of the last glacial maximum (LGM ~17 kcal BP), another cool and wet period (Dewar & Stewart 2012, 2017; Dewar et al. 2023). The presence of a single marine shell (*C. granatina*) and one fish vertebra suggest people were highly mobile, or that they had trading connections with people at the coast and/or the Orange-Gariep River 30-40 km away. For example, a cluster of sites at Jakkalsberg is 30 km due north on the Orange River and has produced assemblages abundant with fish and sheep (Brink & Webley 1996; Halkett 2001).

Although sheep and probable sheep bones were identified (awaiting ZooMS confirmation), it appears that the people occupying the site relied heavily on a range of wild bovid species for daily subsistence (Table 3). Unless the unidentified small/medium and medium/large bovid bones are sheep and cattle, which is possible, this pattern suggests that the sheep were not the primary source of meat and they may have been kept for milk (dairy herd) or as a form of social risk reduction (a form of reciprocal gift exchange) to maintain social ties within a highly mobile and often spatially separated community (Hopper & Dewar 2022).

The hunting strategy remains the same across all layers reflecting an opportunistic use of the local niche, typical of sites from the LIA along the Namaqualand coast (Dewar 2008). People primarily encountered or preferentially hunted/slaughtered size 2 and 3 ungulates but also broadened the diet with the contribution of small mammals and tortoises (Tables 3 & 4). Evaluating the diet breadth using just the ungulates produced unbiased Simpson's evenness values (1-D') that consistently reflect a highly mobile hunting strategy (>0.75) that, as predicted, has a strong negative correlation with NTAXAprey and MNIprey (Table 3). When the full range of prey species (ungulates, small mammals, and tortoises) are included in the evenness index, layer 2 (0.63) and layer 6 (0.58) present a narrower diet, reflecting longer visits focusing on a particular resource – tortoises. As Morin et al. (2021) have recently shown, tortoises are a highly ranked species, with very high caloric returns, and should always be taken when encountered; however, while these are robust sample sizes, the hunting strategy remains statistically the same as the general pattern above. There are also between 15 and 21 ostrich eggshells in the deposit with ~9 in layer 2 alone, which could also have contributed to the diet before becoming raw material for flasks, beads, and/or pendants. For example, there are two OES flask mouth fragments in layer 2 and one in layer 1. Ostriches are ubiquitous to the Namaqualand coastal desert and their shells are found across the landscape (Dewar 2008).

The high frequency of heat-altered bone and low evidence for carnivore activity suggests that the bulk of the macrofauna were brought to the site anthropogenically; however, the micromammals are likely to have been deposited by birds of prey or small carnivores as they lack the intense modifications (acid etching, lack of postcranial elements) present when consumed by humans (Dewar & Jerardino 2007).

Cultural material

The OES assemblage at Spitzkloof D does show evidence of bead manufacturing (Table 6) with 32 ostrich eggshells in early bead-manufacturing stages (1 to 6). Figure 5 reveals two groupings of beads, group 1 contains beads from layers 1, 2, 3, and 6 that are less than 6 mm in diameter, and group 2 contains beads from layer 2 that are 8 mm or greater in diameter. These groupings do not seem to be based on time periods since beads from all bead-containing layers are contained in group 1, but the group 2 beads come exclusively from layer 2. Although layers 1 and 2 date to within the last 2000 years, these layers do not contain the largest beads, a trait which has been suggested to relate to herders (Jacobson 1987a, b; Smith et al. 1991, 2001); however, others emphasise the variability in bead sizes after 2000 years (e.g., Kandel & Conard 2005; Dewar 2008; Miller 2016; Miller & Sawchuk 2019), which is reflected in the OES bead assemblage from Spitzkloof D and the contemporary sites along the coast (Fig. 5). Instead, the bimodal distribution in OES beads observed at Spitzkloof D may either indicate more than one person was making beads (multiple trading partners), or that these beads came from or were destined for two or more different items of personal ornamentation.

Figure 6 and Table 8 present bead aperture diameter compared to bead thickness. This was explored because Orton (2008) found that in Namaqualand, when bead aperture increases in size due to wear, thickness is reduced. Although a few of the beads with the largest apertures are the thinnest, which is what was expected (a negative trend), five beads with the largest apertures (from layer 2) represent the thickest beads (circled in Fig. 6). Interestingly, four of the five beads are the same ones that make up group 2 in Figure 5, suggesting that the beads in group 2 are different from those in group 1 (Fig. 5), and that they could represent a single item of jewellery.

Another potential explanation for the variation in bead thickness, especially since none of the beads with the largest apertures show any outward expressions of wear or evidence for being burnt (shown to delaminate eggshell layers), is the environmental conditions experienced by the female ostrich before laying (Knight 1995). Research on archaeological shell has shown that there is a relationship between OES thickness and humidity (Ecker et al. 2015) where ostriches that breed in very arid environments tend to have a thicker eggshell to protect the embryo from drying out, versus where ostriches breed in more humid environments that leads to a thinner shell to increase gas exchange. In modern birds, Stein and Badyaev (2011) found that these changes can occur rapidly within a single season. If this was the case at Spitzkloof D, then the fact that the thickest beads occur in layer 2 may suggest some drier periods within an overall slightly wetter period in the region than today. Alternatively, these thicker shells may have been collected elsewhere or traded in as finished beads.

All the potsherds at Spitzkloof D, except for one in layer 6, come from layers 1 and 2 which are also the sheep and probable sheep bearing layers. None of the sherds from Spitzkloof D are decorated but since Orton (2012) suggests that non-rim sherds are adiagnostic, it is impossible to accurately characterise this assemblage as containing only undecorated pottery. The two rim sherds identified in the assemblage are both undecorated. Based on Sadr & Smith's (1991) pottery classification, the single lug found in layer 2 can be identified as either incised lugged ware or undecorated lugged ware. Lugged ware is easily suspended and is believed to have been used by herders in response to the need for greater mobility (Orton 2012), although foragers also used lugged pottery (Bollong et al. 1997); however, as this sherd was recovered from layer 2, which also contains probable sheep, it does suggest an occupation by people who were keeping sheep or at least by people who had access to them.

Although lithic analysis is ongoing, Tables 10 and 11 reveal that the assemblage consists of informal or expedient artefacts of mostly quartz flakes. In northern and central Namaqualand, the sites of SK400, KV502, and DP2004/014, which date to between AD 1326 and AD 1718, also lack a significant number of formal/retouched tools with milky quartz predominating (Dewar 2008). Elsewhere, in the Middle Orange River region, lithic assemblages also become less formal between 2000- and 120-years BP (Beaumont & Boshier 1974; Beaumont et al. 1995; Parsons 2004). Informal quartz tool industries are also seen at Bloeddrift 23 in northern Namaqualand (Smith et al. 2001), Skorpion Cave in southern Namibia (Kinahan & Kinahan 2003), Apollo 11 in southern Namibia (Wendt 1972), and the Elands Bay sites from 1000 BP onwards (Orton 2006). These Late Holocene toolkits, with relatively low acquisition and replacement costs, are believed to be connected to highly mobile herding people, where curating stone may be cumbersome (cf. Orton 2012).

Trade and interaction at Spitzkloof D

Although the trade beads (Table 8) and iron implements are awaiting further analysis, they point to an occupation by people who were connected not only to the coast but also more broadly with Iron Age agro-pastoral Bantu groups living further north-east (Elphick 1985). Despite historical (e.g., Thom 1952; Goodwin 1956; Elphick 1985) documentation suggesting that herders had a robust trade network, exchanging livestock for metal spear points, metal jewellery, OES and glass beads, there is little archaeological evidence for this in Namaqualand. Thus, finding iron implements and glass beads adds much needed evidence for trade and social interaction in the region.

Although a relatively rare find in Namaqualand, glass trade beads are important as they can be used to identify regional and foreign trade networks as well as social and economic change (Comaroff & Comaroff 2006). While the four glass beads may have been left by Europeans, it is more likely they were left by local people since the area is very remote and there are no farms in the region. These four glass beads (Table 9) are significant as they add ~35% more beads to the total Namaqualand collection – there are only three other published sites in Namaqualand which contain a total of 11 glass beads. Five come from Bethelsklip (Webley 1986), six from KK002 (Orton 2014), and a final glass trade bead comes from LK2001/010A (Orton 2012). Little is known about the specifics of the glass bead trade in Namaqualand but ethnohistorical documents suggest that these beads were highly prized (e.g., Smith & Pheiffer 1992; Comaroff & Comaroff 2006). In Namibia, Kinahan's (2000) research found that the regional trade in glass beads, likely initially coming from European seafarers, was controlled by wealthy herders until the mid-nineteenth century when British colonialists had set up permanent settlements that disrupted these regional trade networks (Kinahan 2000).

Spitzkloof D also contains two iron implements with one likely being a spearhead (at the interface of the burrow layer). This is also a rare find in Namaqualand with, to our knowledge, only four other archaeological sites containing iron implements. These include one iron rod at KK002 (Orton 2014), one iron arrowhead at LOR 16 (Miller et al. 1998), and seven small iron fragments as well as one iron bead at Jakkalsberg B (Miller & Webley 1994; Webley 1997). Although analysis is ongoing it does appear that the pieces from Spitzkloof D were manufactured using folding and cold working (an indigenous method) as opposed to hot-working with a bloomery furnace, for example, and thus they were likely sourced through indigenous trade networks which are known to have traded goods over hundreds of kilometres (e.g., Orton et al. 2011; Orton 2014; Stewart et al. 2020).

7. Conclusions

The preliminary results from the first excavation of Spitzkloof D rockshelter in northern Namaqualand identified six deeply stratified layers which consist of large hearths, ash deposits, and multiple pits with one having potential votive (faunal) offerings in its base. Faunal analysis reveals a consistently broad, highly mobile subsistence strategy consisting of possible low-intensity sheep-keeping and consumption of wild species during the LIA, a climatic period somewhat more humid than today. Accounting for the small species, the diversity evenness index indicates that layers 2 and 6 may have seen longer occupations with narrower diets focusing on tortoises, although they are statistically the same as the other faunal signatures. Radiocarbon dating, pottery, and lithic characteristics, as well as probable sheep remains are suggestive of herder occupation during the accumulation of at least the two most recent layers. Glass trade beads and iron implements, along perhaps with fish and limpet shell remains, hint that the people occupying Spitzkloof D were part of an extensive trade/interaction network within Namaqualand that also reached further north and west. Future work will focus on increasing sample sizes through continued excavation, a detailed study of the lithics and the trade items including the glass beads and iron implements, and additional sampling for radiocarbon dating.

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THE FAUNA FROM RATHO KROONKOP, A RAIN-CONTROL SITE IN THE SHASHE-LIMPOPO CONFLUENCE AREA, LIMPOPO PROVINCE, SOUTH AFRICA

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ABSTRACT
Rain-control in the Shashe-Limpopo Confluence Area (SLCA) is one sphere in which hunter-gatherer and farmer interaction is archaeologically visible. One avenue of examining this interaction is through faunal analysis. This paper presents an updated taxa list for one of the identified rain-control sites in the SLCA – Ratho Kroonkop. By identifying the taxa accumulated at Ratho Kroonkop and contextualising them using radiocarbon dates and relevant ethnographies, we were able to determine that particular animals were significant to the people who utilised the location as a rain-control site. Additionally, we were able to establish that this significance continued from the K2 period (AD 1000-1220) to the historic period.

Keywords: faunal analysis, Shashe-Limpopo Confluence Area, rain-control, Middle Iron Age

1. Introduction

The Shashe-Limpopo Confluence Area (SLCA) is a biodiverse landscape that has played host to people since the Earlier Stone Age (Kuman et al. 2005; Pollarolo & Kuman 2009). Hunter-gatherers have occupied the broader area since at least ca. 10 890 BC (at Balerno Main Shelter; van Doornum 2008) and continued to do so after the first farmers moved into the SLCA at around AD 350 (Hall & Smith 2000; Huffman 2000; van Doornum 2008; Forssman 2013, 2014). In the Limpopo River Valley, there was also a succession of large, complex societies, beginning with the 10th century village of Schroda, followed by K2 (aka Bambandyanalo) and ending with Mapungubwe (Fouché 1937; Gardner 1963; Eloff & Meyer 1981; Hanisch 1981, 2002; Voigt 1981a, 1983; Calabrese 2000, 2007; Huffman 2000, 2009, 2015; Hanisch & Maumela 2002; Nettleton 2002; van Schalkwyk 2002; Antonites AR et al. 2016). The SLCA is an area of archaeological importance because, on both sides of the Limpopo River, it is a landscape within which hunter-gatherers interacted with farming communities, and it is where farming communities developed societal complexity and extensive trade links (e.g., Manyanga 2006; Huffman 2007; Chirikure et al. 2016; Manyanga & Chirikure 2019).

One of the contexts in which the interaction between hunter-gatherers and farmers in the SLCA has been studied is at rain-control sites. These sites (Fig. 1) are significant for understanding interactions between hunter-gatherers and farmers in the SLCA as these are spaces where hunter-gatherer meanings and thoughts of rain, and the landscape, were incorporated into farmer imaginings of rain and rain-control (Schoeman 2006a). Rain-control sites are hills that have links to water – rock tanks or places where water pools, or where it flows in streams and rivers at their base – or they are caves, crevices or cupules where rain medicine could be stored or placed (Schoeman 2006a). The term ‘rock tank’ denotes an eroded depression in the sandstone where water would have collected naturally (see Schoeman 2006a).

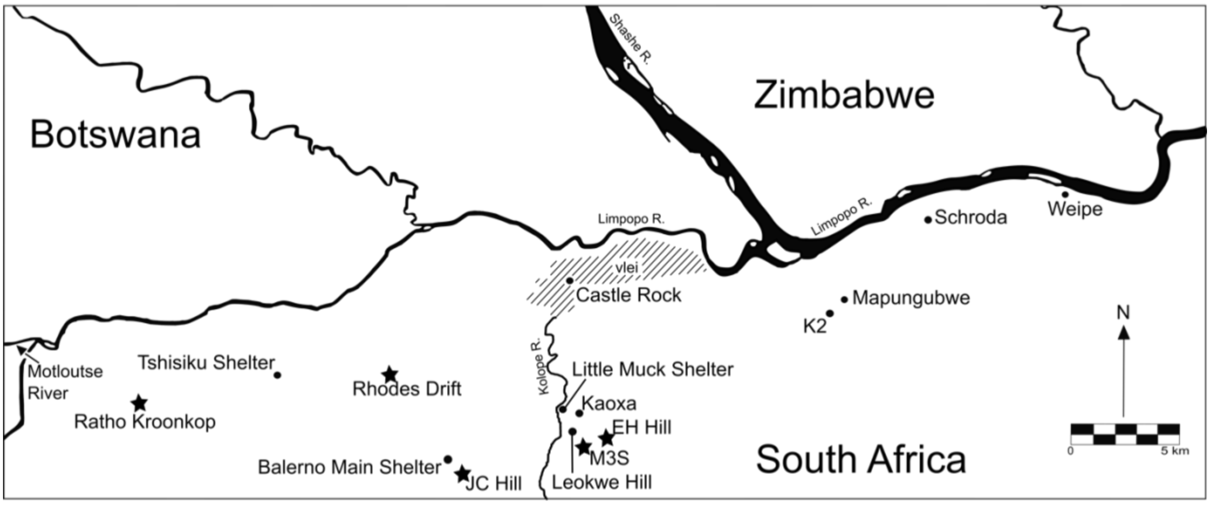

Figure 1. Map of the Limpopo Valley with important archaeological sites; rain-control sites are indicated by stars.

Initially four rain-control sites were identified, named JC Hill, M3S, EH Hill and Rhodes Drift (see Murimbika 2006; Schoeman 2006a, b) with a fifth, Ratho Kroonkop (Fig. 1), being identified later (Schoeman 2009, 2013, 2020; Brunton et al. 2013). From these sites, diagnostic ceramics, glass and shell beads, botanical and faunal remains, figurine fragments, gravel floors and the remnants of grain bins were recovered during excavations (Schoeman 2006a, b). Based on several lines of evidence, including historical and modern ethnography, Schoeman (2006a, b, 2009, 2013, 2020) and Murimbika (2006) argued that these sites were not residential sites, and that they were utilised by both hunter-gatherer and farmer ritual specialists potentially into the historic period (after AD 1600) due to the presence of Letaba ceramics (which are associated with Venda-speakers, e.g., Loubser 1989).

The large faunal assemblage from Ratho Kroonkop (discussed here) accumulated as part of the ritual rain-control process, however, ritual is not the only behaviour which forms large faunal assemblages. Feasting and consistent disposal in middens and near homesteads also results in large, concentrated faunal assemblages within a confined space. Many of the largest faunal assemblages analysed in the SLCA are the result of consistent disposal of faunal remains in middens or specific areas within or near residential sites (e.g., Voigt 1981a, b, 1983; Hutten 2005; Manyanga 2006; Badenhorst et al. 2011, 2016; Abatino 2021). In contrast to this, feasting is a time-specific event which results in large, concentrated faunal assemblages. It is a communal activity where food (often comprising species which are not normally consumed as part of every-day life) and drink are consumed (Dietler & Hayden 2001; Hayden 2001, 2009; Magoma et al. 2018). One way to differentiate between the behaviours that formed a faunal assemblage is to identify the taxa or species within that assemblage.

Identifying the taxa present at an archaeological site, both spatially and temporally, can reveal patterns in species selection. By utilising these data, researchers can identify the significance of certain taxa by, for example, examining relevant ethnographies and rock art in the SLCA and southern Africa more broadly. One example of this from past hunter-gatherer societies in southern Africa is the importance of the eland, both as a food source and spiritually (e.g., Lewis-Williams 1997; McGranaghan & Challis 2016), or the kudu (e.g., Eastwood & Blundell 1999; Eastwood 2006, Pwiti et al. 2007, Nhamo 2020a, b). Both wild and domestic taxa are important for archaeological and historically recorded farming societies, but the importance of particular species varies from context to context (e.g., Quinn 1959; Shaw 1974; Mönning 1978; Krige & Krige 1980; Voigt 1983; Schapera 1984; Aukema 1989; Ouzman 1996).

In the SLCA, previous faunal studies focusing on the Middle Iron Age (ca. AD 900-1300) have improved our understanding of livestock management (e.g., Voigt & Plug 1981; Plug & Voigt 1985; Plug 2000; Hutten 2005; Manyanga 2006; Fatherley 2009; Badenhorst et al. 2011, 2016; Raath 2014; Antonites AR et al. 2016; Abatino 2021). Most of these studies focused on assemblages from sites occupied by farming communities, and for those few focusing on hunter-gatherer sites they have not included in-depth faunal analyses. This has left a distinct bias in the faunal record.

South of the SLCA, in the Soutpansberg, faunal studies on archaeological material from Venda sites showed that there were some differences between the main settlements in the area, and that the faunal remains could be used to understand who occupied particular areas of the settlements (Loubser 1991; de Wet-Bronner 1994a, b, 1995a, b; Antonites AR & Kruger 2012). For example, cattle herds were maintained through timed slaughters (Thorp 1984; de Wet-Bronner 1994a) and the people who occupied these sites had varied diets (including riverine and wild animals), depending on their status or on external conditions such as the rinderpest (de Wet-Bronner 1995a, b; Antonites AR & Kruger 2012).

Adding to the above faunal studies from the SLCA is a previous study on the remains from Ratho Kroonkop (Brunton et al. 2013). Brunton and colleagues (2013) examined the faunal remains from one of the site's features, namely rock tank 2 (Fig. 1), and established a taxa list for the site that was subsequently used to support Schoeman's (2006a, b, 2009, 2013, 2020; see also Murimbika 2006) argument that Ratho Kroonkop is a rain-control hill.

In hunter-gatherer and farmer society, a variety of animals are associated with rain, places of water, and rain-control. Our information regarding this is derived from historically gathered ethnographies and we acknowledge the criticisms and drawbacks of using ethnographies to draw analogies (see Childe 1956; Ascher 1961; Gould & Watson 1982; Wylie 1985; Lane 1995, 1998). Our study attempts to overcome these critiques by drawing from multiple ethnographies collected from both hunter-gatherer (Bleek 1933a, b; Orpen 1984; Yellen 1993a, b; Tanaka 1996; Imamura 2001) and farmer groups (Krige 1957; Quinn 1959; Stayt 1968; Hammond-Tooke 1974a, b; Shaw 1974; Mönning 1978; Schapera 1984; de Heusch 1985; Aukema 1989; Matenga 1993), and the ethnoarchaeological study by Murimbika (2006), to form analogies to interpret the faunal remains from Ratho Kroonkop. Lastly, for hybrid groups, we use 19th century accounts of Northern Cape Korana (Engelbrecht 1936) and descriptions of the Kattea in Limpopo Province, provided by Van der Ryst (2003).

Among hunter-gatherer groups, several animal taxa were important for various reasons. In the context of rain, one of the most important was referred to as the "water-bull" (Bleek 1933a: 376). This term, denoting a rain animal in a painting, should be viewed in its post-contact context and can be seen as referring to a large animal (e.g., a large snake such as a python or large mammal such as a rhinoceros; Bleek 1933a). Other taxa directly associated with water and rain in hunter-gatherer ontology include fish, frogs, tortoises and snakes (Bleek 1933b; Brunton et al. 2013). Other animals in hunter-gatherer ontology also have *n!ow*, a life-force which can also influence the weather at times (Barnard 1992). These animals include giraffe, eland, gemsbok, kudu, red hartebeest and either black or blue wildebeest. Almost all these animals are also depicted in rock art throughout southern Africa (e.g., Lewis-Williams & Dowson 1990, 1993; Lewis-Williams 2003; Lewis-Williams & Pearce 2004; Challis 2005; Pwiti et al. 2007; Challis et al. 2008, 2013; McGranaghan & Challis 2016; Guenther 2017; Nhamo 2020a, b).

Interestingly, farmer thinking about rain does not abandon wild animals entirely, although the main emphasis is on the use of domesticates in rain-control (e.g., Feddema 1966; Hammond-Tooke 1974b; de Heusch 1985; Murimbika 2006). These wild animals include guinea fowl, hyraxes, eland, monitor lizard, klipspringer, and the use of rhino horns to store rain medicine (Feddema 1966; Schapera 1971; de Heusch 1985; Murimbika 2006). The strongest hint potentially lies in the repeated links in both farmer and hunter-gatherer ontology about rain with snakes, and specifically a python (e.g., Schapera 1971; Schmidt 1975; de Heusch 1985; Hoff 1997; Hollmann 2007; also see Schoeman 2006, 2009, Whitelaw 2017 and Croll 2023 for discussions).

Several ethnographies of farming societies mention the slaughter of a 'black beast', usually a black bull or a black sheep (e.g., Feddema 1966; Hammond-Tooke 1974b; de Heusch 1985; Murimbika 2006; Shenjere-Nyabezi 2016, 2022). The colour of the animal was said to either call the dark rain clouds or imitate them (Murimbika 2006). Importantly, the animal being sacrificed must not make noise and thus would not disturb the ancestors (de Heusch 1985).

The purpose of this paper is to expand the previous taxonomic list, detail the taxa identified from all areas of Ratho Kroonkop, and explain spatial patterning in the faunal remains. This paper also seeks to identify whether we can gain deeper insights into ritual through examining the composition of the faunal remains, within the context of rain-control. This might be possible because animals do not only serve as a source of food for humans but also as pathways for expressing social concepts through feasting and ritual use (Morris 2012), and as expressions of social identity (e.g., as figurines or totems; Matenga 1993; Hanisch & Maumela 2002; Anderson 2009; Dietler 2011). Additionally, by contextualising animals using relevant ethnographies (e.g., Orpen 1874; Bleek 1933a, b; Quinn 1959; Hammond-Tooke 1974b; Shenjere-Nyabezi 2016, 2022), we can attempt to understand the potential significance of certain animals in the context of rain-control.

2. Site description

Ratho Kroonkop is on the far west of the SLCA in South Africa (Fig. 1), approximately 35 km from Mapungubwe (Schoeman 2009). It is a steep-sided sandstone hill that rises roughly 650 m above the valley floor. It is capped by exposed sandstone and flanked to the east by a sandstone ridge. To the west of Ratho Kroonkop is a flat plain, which the Limpopo River likely flooded. Mopane trees interspersed with grasses predominate in areas that are not currently farmed. The western edge of the flat plain is marked by a riparian forest lining the Limpopo River, which is 4.14 km from Ratho Kroonkop in a direct line.

Paleoclimatic records for the region – based on oxygen, nitrogen and carbon isotopes – show that the rainfall and temperature varied between AD 900 and the present (e.g., Smith et al. 2007, 2010; Woodborne et al. 2015). These isotopic analyses indicate that, during the Little Ice Age (AD 1300-1800; Tyson et al. 2000), there was a ±1.4°C decrease in temperature accompanied by a decrease in rainfall (Woodborne et al. 2015). The SLCA also plays host to several different environment types including woodland in the form of a riparian forest, rocky hills, and grasslands (e.g., Eastwood & Blundell 1999; Plug 2000; Rutherford et al. 2010). All of these are fed by numerous waterways (DWAF 2006; SANBI 2018).

Getting to the summit of Ratho Kroonkop is not an easy task; there are two possible entry points, one to the east and one to the northwest (Figs 2 & 3). The eastern route to the summit is an almost sheer rock face with few footholds. Access from the northwest is easier as most of the climb is up a gentler slope, with only a few metres of sheer rock face at the very top (currently made easier to climb by a ladder). This is followed by a tunnel formed by large sandstone boulders.

There are four visible rock tanks on Ratho Kroonkop, only two of which contained material culture (Fig. 4). The central site area also contained material culture as well as circular concentrations of gravel that may be remnants of floors, and *daga* fragments. Numerous cupules were carved into the sandstone on the hilltop, as was a *mankala* board near the top of the entrance tunnel (see Townshend 1979 for further description).

Ratho Kroonkop was excavated by Alex Schoeman, Bronwen van Doornum, and staff and students from the Universities of Pretoria and Botswana, from 2006-2008. They used standard archaeological techniques and all material was dry-sieved with a double sieve; the top sieve comprised 5 mm mesh while the bottom was a fly screen (<1 mm). Within rock tank 1, 1 m^2 was excavated; rock tank 2 had 3 m^2 excavated and the central area was spread over 33 m^2 (Fig. 3). Bedrock was reached in all excavated squares except in rock tank 2 where termite activity prevented further excavation due to the hardness of the soil and mixing of artefacts. The faunal remains from both rock tanks were deliberately placed in the tanks – in rock tank 2 this happened in one dumping episode and in rock tank 1 this occurred during at least three dumping episodes, based on stratigraphy. Temporally, there is little difference between the faunal assemblages dating to the K2 (area 1; rock tank 2 and area A) and the Venda/historic periods (area 2; rock tank 1 and areas B-D).

Figure 2. The narrow tunnel at the northwestern edge of Ratho Kroonkop, taken from the top of the ladder (photo by K. Croll).

Several radiocarbon dates have been obtained for Ratho Kroonkop, one of which was previously reported by Brunton et al. (2013). Samples (Table 1) were obtained from central area A (samples 613661 and 613662) and C (sample 613663), rock tank 1 (samples 613664, 613665 and 613666) and rock tank 2 (Beta-28653; Brunton et al. 2013), providing dates indicating the use and/or occupation of

Ratho Kroonkop during the K2 and K2-Mapungubwe transition periods (TK2), as well as its historical use. The dates from rock tank 1 were obtained from charcoal in the bottom, middle and top of the rock tank deposit. The dates from the central area were obtained from charcoal associated with gravel features and animal bone clusters. Overall, the dates indicate that different areas of the site were likely used at different times: first during the K2 and TK2 periods and second during the Venda and/or historic period.

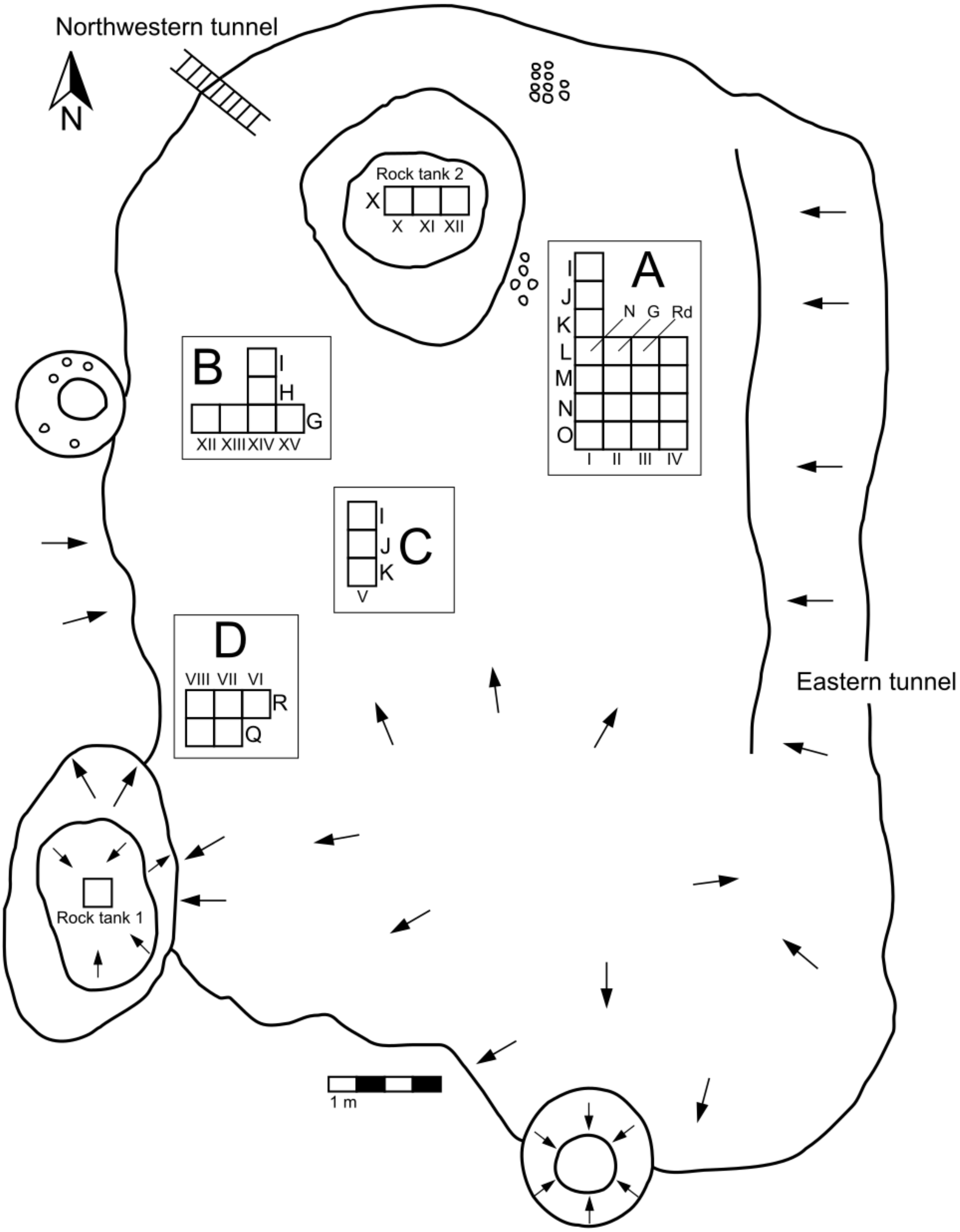

Figure 3. Plan view of the summit of Ratho Kroonkop showing the areas excavated (A-D), the location of cupules (circles) and the slope direction (arrows) across the surface.

Figure 4. Photo of rock tank 1, taken looking south (photo by A. Schoeman).

Table 1. List of calibrated dates and their locations; dates obtained from Beta Analytical and calibrated with OxCal (see Bronk Ramsey 2009, 2021) and SHCal20 (see Hogg et al. 2020).

Sample number	Location	Calibrated date	Uncalibrated date
R_Date 613661	I/L 38cm in situ charcoal	cal. AD 1045-1218 (cal. 905-732 BP)	940±30 bp
R_Date 613662	III/M FP 2A charcoal	cal. AD 994-1152 (cal. 956-798 BP)	1020±30 bp
R_Date 613663	V/J 2B	cal. AD 1666-post AD 1950 (cal. 284 BP-post 0 BP)	190±30 bp
R_Date 613664	Rock tank 1 last spotted dark khaki	cal. AD 1684-post AD 1950 (cal. 266 BP-post 0 BP)	150±30 bp
R_Date 613665	Rock tank 1 dark khaki	cal. AD 1696-1948 (cal. 254-2 BP)	120±30 bp
R_Date 613666	Rock tank 1 1A	cal. AD 1665-post AD 1950 (cal. 285 BP-post 0 BP)	200±30 bp
Beta-28653	Rock tank 2 (Brunton et al. 2013)	cal. AD 1040 – 1240 cal. AD	860±40 bp

3. Methods and materials

The faunal remains which form the basis of this study were excavated from Ratho Kroonkop during 2006-2008. A sample of faunal remains were previously analysed by Brunton et al. (2013). Our study expands on their work by including the fauna from all excavated areas of Ratho Kroonkop, the taxonomic results of which are presented here. This study utilised the method of Driver (1991, 2005), which facilitates data comparison with Brunton et al. (2013). Bovid size classes follow Brain (1974) and size classes for unspecified mammals, reptiles, carnivores, and birds were adapted from Reynard et al. (2016; Table 2).

Table 2. Groups and examples of indeterminate mammals, carnivores, and rodents (adapted from Reynard et al. 2016).

Group	Mammal	Carnivore	Rodent
Small	Bovid I, hyrax	Small wild cat	Mouse, shrew
Medium	Bovid II, pig	Jackal, dog	Rat
Large	Bovid III, horse	Lion, leopard	Porcupine
Very large	Bovid IV, elephant	-	-

The comparative faunal collections at the Evolutionary Studies Institute at the University of the Witwatersrand, and Ditsong National Museum of Natural History in Pretoria, were used to identify the faunal specimens to taxon, when possible. Peters (1988), Payne (1985), Prummel and Frisch (1986), Halstead et al. (2002), Zeder and Pilaar (2010) and Zeder and Lapham (2010) were used to confirm domesticates (*Bos taurus* and *Ovis/Capra*). Taxonomic classification follows Meester et al. (1986). Taxa were quantified by the Number of Identified Specimens (NISP; see Klein & Cruz-Uribe 1984) and normalised using normed NISP (nNISP; Grayson 1984; Grayson & Frey 2004; van Pletzen-Vos et al. 2019). Minimum Numbers of Elements (MNE; e.g., Lyman 2019a, b) were used to quantify faunal elements. Minimum Number of Individuals (MNI) were not calculated due to the difficulty of establishing a standardised method for determining the MNIs across the site. A full taphonomic analysis has been conducted on all identified remains (Croll 2023) and these data will be presented in a future publication.

The faunal remains were divided by excavated area and according to spits (excavated in 5 cm levels) to ensure comparability across the site, even where stratigraphy had been recorded. Radiocarbon dating of the site also allowed for temporal grouping of the different site areas – rock tank 2 was likely contemporaneous with central area A and rock tank 1 was likely contemporaneous with central areas B, C and D (Fig. 3). Of all these areas it was only in rock tank 1 that multiple dumping events of faunal remains occurred, and in central area A that multiple gravel floors were constructed (Schoeman 2006a, b, 2009), which indicates episodic use of the site.

4. Results and discussion

A total of 264 040 specimens from all excavated areas of Ratho Kroonkop were sorted into identifiable and non-identifiable categories (Table 3). Overall, the assemblage was highly fragmented. The faunal remains from rock tank 1 were the best preserved (25% of specimens were identified). The preservation of faunal remains from rock tank 2 was the lowest (7% of specimens identified), which was likely due to intensive termite activity within the rock tank.

Table 3. Number of Identified Specimens (NISP) from Ratho Kroonkop.

Location	# Identified specimens	# Unidentified specimens	Total # of specimens	% ID	% non-ID
Rock tank 1	9299	27 767	37 066	25%	75%
Rock tank 2	9814	127 813	137 627	7%	93%
Central area A	4865	25 042	29 907	16%	84%
Central area B	3679	20 603	24 282	15%	85%
Central area C	1747	17 317	19 064	9%	91%
Central area D	1844	14 250	16 094	12%	88%
Total	**31 248**	**232 792**	**264 040**		

Taxa

A total of 49 taxa were identified from the faunal remains from Ratho Kroonkop (see Supplementary Online Material [SOM] Table 1), excluding those specimens only identified to size class. Mammals, birds, reptiles, fish, and molluscs are present at Ratho Kroonkop. The most common animals identified are indeterminate small fish (NISP=11 594), indeterminate small terrestrial gastropods (NISP=5992), and indeterminate medium mammals (NISP=4005). *Barbus* sp. was identified from cranial plates. The most common bovid size class is Bov II (NISP=959), followed by Bov I (NISP=272). The most prevalent bovid identified to genus/species were *Aepyceros melampus* (impala, NISP=95) and *Redunca* sp. (reedbuck, NISP=35).

We have grouped the faunal assemblage from the whole of Ratho Kroonkop into two areas based on the radiocarbon dating of the site; area 1 includes rock tank 2 and central area A and area 2 includes rock tank 1 and central areas B, C and D. By doing so, we confirm that there are differences between the previous study by Brunton et al. (2013) and this study (SOM Table 1). First, this study analysed the entire faunal assemblage from all excavated areas of Ratho Kroonkop whereas Brunton et al. (2013) only analysed a sample from rock tank 2. Second, this study has identified several new taxa: cf. *Soricidae* (probable shrew), *Panthera pardus* (leopard), Hyaenidae gen. et. sp. indet. (hyena); *Felis silvestris* (African wild cat*),* *Genetta* cf. *genetta* (probable small-spotted genet), Herpestidae gen. et. sp.

indet. (mongoose), *Phacochoerus africanus* (common warthog), *Hippopotamus amphibius* (hippopotamus), *Connochaetes taurinus* (blue wildebeest), *Alcelaphus buselaphus* (red hartebeest), *Oreotragus oreotragus* (klipspringer), *Pelea capreolus* (grey rhebok), *Hippotragus equinus* (roan*), Hippotragus niger* (sable), *Tragelaphus scriptus* (bushbuck), *Redunca fulvorfula* (mountain reedbuck), *Kobus ellipsiprymnus* (waterbuck) and *Pronolagus randensis* (Jameson's red rock rabbit). Many of the newly identified taxa were only found in rock tank 1 or the central excavated areas and thus would not have been in the assemblage analysed by Brunton et al. (2013).

The presence of *Diceros bicornis*/*Ceratotherium simum* (rhinoceros, NISP=14), *Hippopotamus amphibius* (NISP=3) and *Giraffa camelopardalis* (giraffe, NISP=3) are interesting due to these animals' links with rain, rain-animals and rock art (e.g., Lewis-Williams & Dowson 1990, 1993; Ouzman 1995a; Eastwood & Blundell 1999; Eastwood & Cnoops 1999; Hall & Smith 2000; Lewis-Williams 2003; Lewis-Williams & Pearce 2004; Challis 2005; Eastwood 2006; Challis et al. 2008, 2013; Boeyens & Van der Ryst 2014; McGranaghan & Challis 2016; Guenther 2017). The rhinoceros remains were identified exclusively from the two rock tanks, whereas only one giraffe phalange was identified from rock tank 2. All three of these animals are depicted in the engraved and painted rock art throughout southern Africa (Lewis-Williams & Dowson 1990, 1993; Ouzman 1995a; Eastwood & Blundell 1999; Eastwood & Cnoops 1999; Hall & Smith 2000; Lewis-Williams 2003; Lewis-Williams & Pearce 2004; Challis 2005; Eastwood 2006; Challis et al. 2008, 2013; Boeyens & Van der Ryst 2014; McGranaghan & Challis 2016; Guenther 2017). The placement of faunal remains from animal taxa strongly associated with rain and water, into wet places (i.e., the rock tanks), strengthens the case for Ratho Kroonkop being a rain-control site.

Many of the bovid and large mammal taxa represented are associated with water (Skinner & Chimimba 2005), for example *Syncerus caffer* (African buffalo*)*, *Tragelaphus scriptus*, *Redunca arundinum* (southern reedbuck*)*, *Redunca fulvorfula*, *Kobus ellipsiprimnus* and *Aepyceros melampus* (Skinner & Chimimba 2005). Additionally, *Tragelaphus strepsiceros* (greater kudu) and Rhinocerotidae sp. (black/white rhinoceros) are frequently represented in rock art in the Limpopo Province (e.g., Eastwood & Blundell 1999; Eastwood & Cnoops 1999; Eastwood 2006). Importantly, these large mammal taxa were regarded as spiritually potent and deemed important by both farmer (e.g., Hall & Smith 2000; Boeyens & Van der Ryst 2014) and hunter-gatherer communities (e.g., Eastwood & Blundell 1999; Eastwood & Cnoops 1999) in the Limpopo Province.

Only one definite *Ovis aries* (sheep) distal metapodial was identified from central area A. Identified *Ovis/Capra* remains from central area A comprised one upper premolar and one mandible with all teeth excluding the incisors. From central area C, two lower premolars, one mandible with one premolar and three molars (all worn), and one mandibular ramus, were all identified as *Ovis/Capra*. No *Ovis/Capra* remains were identified from central areas B and D. From rock tank 1, one mandible with one premolar and two molars, one upper premolar, one lower molar, and one maxilla with two premolars and one molar, were all identified as *Ovis/Capra*. Lastly, from rock tank 2 only two lower premolars were identified as *Ovis/Capra*. While this pattern suggests that cranial remains from *Ovis/Capra* were selected by the people using Ratho Kroonkop, the presence of the distal metapodial from *Ovis aries* indicates it is likely that other postcranial remains could also be part of the faunal assemblage. Given the large amount of indeterminate bovid size class II postcranial remains, it is likely that whole *Ovis/Capra* carcasses were brought to Ratho Kroonkop.

Bos taurus remains were also identified from Ratho Kroonkop from all excavated areas except central area B. From central area A, one distal phalange was identified along with an almost complete hyoid from central area C. A carpal, incisor and distal phalange were also identified from central area D. One first phalange was identified from rock tank 1 and a complete astragalus from rock tank 2. The presence of domesticates such as *Ovis/Capra* and *Bos taurus*, even though they are underrepresented when compared with wild bovid taxa, suggests the inclusion of these animals into farmer thinking about rain. Both these taxa are important and, at times, essential components of rain-control in farmer societies (e.g., Shaw 1974; Van der Vliet 1974; de Heusch 1985; Shenjere-Nyabezi 2016, 2022; Magoma et al. 2018). Historical ethnographies from farmer groups in South Africa emphasise the importance of domestic animals, especially black sheep (e.g., Feddema 1966; Hammond-Tooke 1974b, 1993; de Heusch 1985; Aukema 1989; Murimbika 2006), for farmer rain-control rituals; however, wild animals were predominantly chosen by both K2 farmers and Venda-speakers at Ratho Kroonkop even though domestic animals were available.

Skeletal elements

Across Ratho Kroonkop, indeterminate small and medium mammals are represented predominately by cranial and axial elements, with very few limb elements represented. Bovid specimens for size classes I-IV, from all areas of Ratho Kroonkop, are represented predominantly by facial and tooth fragments, maxillae and mandibles as well as fore- and hind-limb elements. Birds are represented by wing and distal limb elements along with a small sample of limb and axial elements. The fish are represented by cranial fragments, including teeth and mandibles, and ribs and vertebrae. Lastly, carnivores are represented predominantly by phalanges, teeth, and tarsals.

Spatial patterns

Spatial patterns were identified in the distribution of the faunal remains from Ratho Kroonkop. The two largest assemblages are from the two rock tanks. Central area A, however, has the largest frequency of medium mammal remains (Fig. 5). The majority of the faunal remains from Ratho Kroonkop are classified as indeterminate medium mammals, due to the high amount of rib and vertebral fragments. It is likely that these are bovid remains which could not be identified to taxa. The skeletal elements represented in the faunal assemblages indicate that smaller mammals (i.e., from bovid size class II to hyraxes) were killed and transported to the summit of Ratho Kroonkop where they were then dismembered, whereas larger animals (bovid size class III to rhinoceros) were killed and dismembered elsewhere with only certain body parts transported to the summit of Ratho Kroonkop.

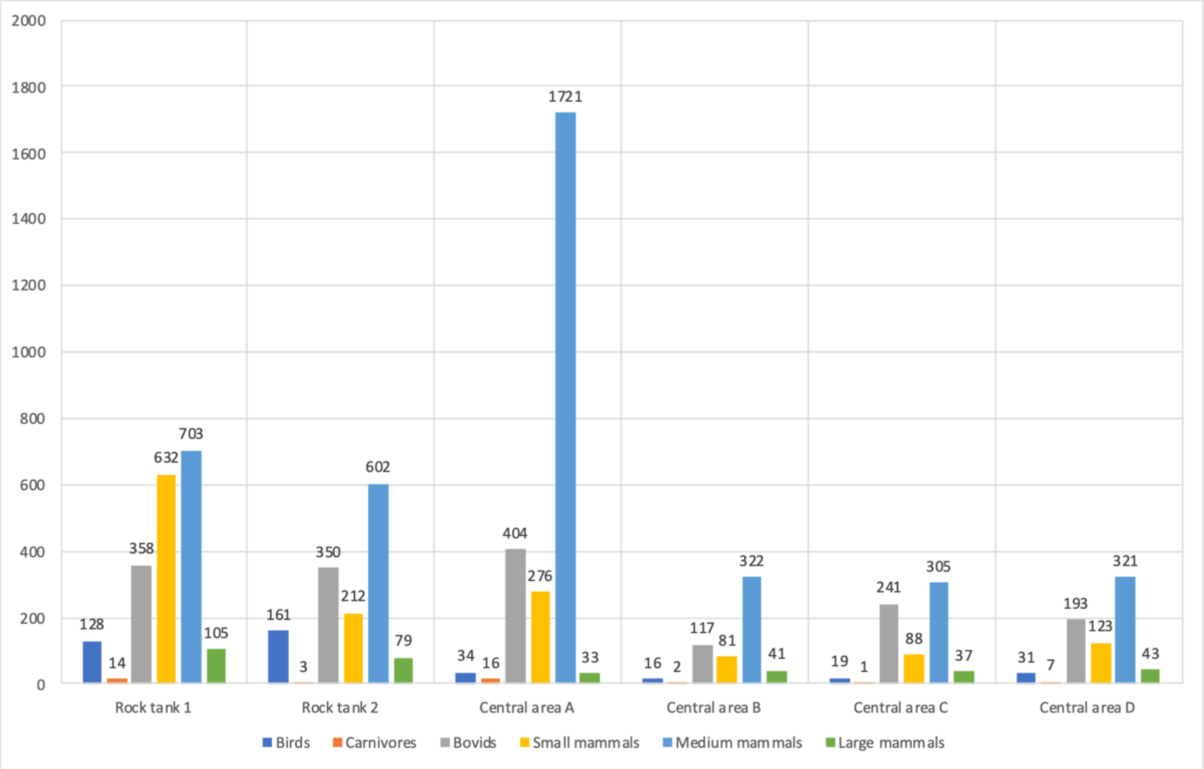

Figure 5. NISP of birds, carnivores, bovids, and small, medium and large mammals from the different areas of Ratho Kroonkop.

Fish remains were identified from all excavated areas of Ratho Kroonkop (Fig. 6). The highest frequencies of fish were from rock tank 1 (NISP=5936) and rock tank 2 (NISP=3819). The large number of fish remains from the two rock tanks further strengthens the possibility that the two rock tanks were used for ritual deposits associated with rain-control. There are strong links elsewhere in southern Africa between fish and rain-control, represented in hunter-gatherer rock art (e.g., Woodhouse 1989; Ouzman 1995b; Challis et al. 2008). Perhaps most important is the link made in the hunter-gatherer ethnography between rain-shamans and going ‘underwater’ (Orpen 1874), and that fish and other water-dependent animals were considered the “rain’s things” (Bleek 1933a: 303; Challis et al. 2008). Thus, while fish are not commonly consumed by farming communities (for exceptions see Engelbrecht 1936 and Shaw 1974), fish were related to rain and potentially rain-control by hunter-gatherer groups in the past (e.g., Orpen 1874; Bleek 1933a, b; Challis et al. 2008).

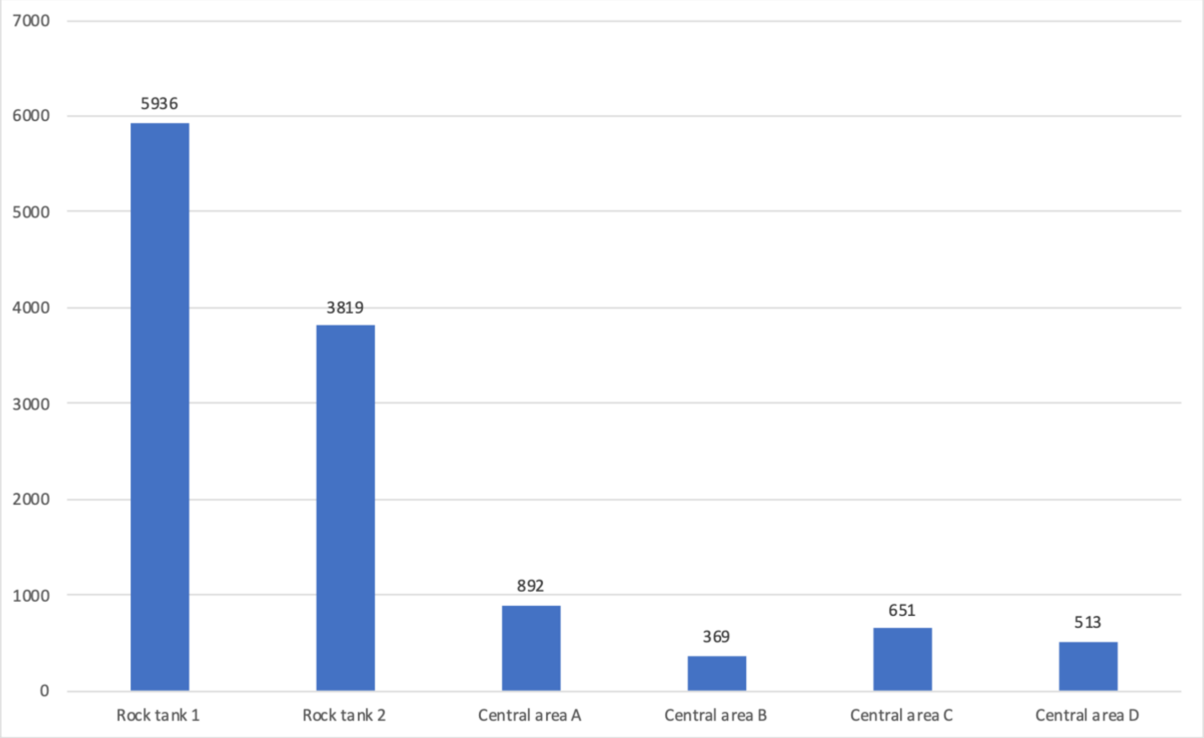

Figure 6. Distribution of fish remains throughout Ratho Kroonkop, represented by NISP.

Spatially, both rock tanks have the most taxonomic diversity and they contained the largest fauna (e.g., rhinoceros, hippopotamus, buffalo and eland); they (especially rock tank 1) also contained the most fish specimens. The central areas predominately have smaller taxa (including bovid size class II, small mammal and some carnivore remains). Overall, there seems to be continuity in animal selection and disposal between the two time periods. The predominant differences lie in the increased frequency of fish remains from rock tank 1 (Venda/historic period), and the increased frequency of indeterminate medium mammal remains from central area A (K2 period). These differences could indicate a change in diet from medium-sized mammals to one more focused on fish, or a change in animal selection for rain-control rituals with increased emphasis on fish from the K2 period to the Venda/historic period.

Accumulation

The faunal assemblages from Ratho Kroonkop could have accumulated during the course of long-term occupation on the summit, or as a result of episodic feasts; however, the faunal assemblages from rock tank 1, rock tank 2 and the four central areas comprise more wild than domesticate species, the former of which were historically and archaeologically important to farmer communities in both mundane and feasting contexts (e.g., de Wet-Bronner 1994a, b; Plug 2000; Manyanga 2006; Badenhorst 2008; Raath 2014; Badenhorst et al. 2016; Magoma et al. 2018; Abatino 2021). The small summit area likely also restricted long-term occupation of the site by the number of people it would have required to form such a large faunal assemblage (e.g., Voigt 1981a, b, 1983; Plug & Voigt 1985; Plug 2000). Given this, along with the dumping episodes in the two rock tanks, it suggests the use of Ratho Kroonkop (and thus the accumulation of the faunal assemblage) occurred on an irregular or intermittent basis by a small group of people.

The combination of taxa associated with water, the deliberate placement of animals into wet places (in this case, the two rock tanks), and the location of Ratho Kroonkop away from homesteads all suggest that this site was used for rain-control purposes. Wet places are important for rain-control and the storage of rain medicine for both hunter-gatherers and farmer communities (e.g., Bleek 1933a, b; Schapera 1971; Berglund 1976; Murimbika 2006; Schoeman 2006a). The vocabulary surrounding rain and rain-control, including the physical materialisation of these rituals, has elements of continuity from hunter-gatherers to farmers in the Limpopo Province.

5. Conclusion

Overall, medium-sized bovids predominate the faunal assemblages from all areas of Ratho Kroonkop. Small mammals are present in the assemblage and were likely snared to add to the diet of the people using the site. Larger bovids, such as eland, buffalo and kudu, are also present. The small sample of domesticates at Ratho Kroonkop indicates the presence of farmers either at the site or nearby. Ultimately, the variety of animals, especially those associated with rain and rain-control by both hunter-gatherers and farmers, suggests that Ratho Kroonkop is a site where practices drew on both hunter-gatherer and farmer cosmologies. This could indicate long-term continuities in how people thought about and related to animals in the SLCA. This study’s significance is two-fold: first, the species list presented here provides a fuller picture of the animals which formed part of the rain-control rituals performed at Ratho Kroonkop; and second, it provides a fauna-based perspective on rain-control in the SLCA. Future research should perform similar analyses on the other rain-control sites identified by Schoeman (2006a, b) and conduct surveys on both sides of the Limpopo River to potentially identify additional rain-control sites in the broader confluence area.

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Supplementary online material

Croll et al. Supplementary Online Material Table 1

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WOODSTOCK ROCKS: FROM ACHEULEAN TO IRON AGE IN THE WATERBERG, LIMPOPO PROVINCE, SOUTH AFRICA

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ABSTRACT

The cliff terrace site, Woodstock Rocks, was exploited occasionally by hominins from the Earlier Stone Age to the Iron Age. A small excavation uncovered an Acheulean quartzite workshop with many flakes, but lacking large cutting tools and without organic preservation. Below the workshop site, a ferricrete river terrace cements Acheulean lithics that include large cutting tools, giant flakes and heavy-duty scrapers. A palaeomagnetic study reveals reversed polarity, implying that the ferricrete formation likely took place during the Matuyama Chron and that the lithic assemblage is older than 780 000 years. The cliff face was painted expansively, but both the Bushman and Iron Age farmer art is faded. There are some rare images including a wild dog, a bird and a possible genet. The southern edge of the cliff terrace has Middle and Later Stone Age lithics on the surface and talus slope, as well as grindstones, and ceramics that include Bambata sherds from six vessels. The proximity to the Mokolo River and sources of rocks for knapping, as well as smooth rock walls for painting ensured repeated Woodstock Rocks visits (not necessarily occupation) for generations of *Homo sapiens* visitors, as well as earlier hominins.

Keywords: Acheulean workshop, Matuyama Chron, Middle and Later Stone Age, ceramics, rock art

1. Introduction

Background and research question

Archaeological studies in the Waterberg remain under-developed, notwithstanding early exploration by Mason (1962), the thorough excavations by van der Ryst (1998, 2006) and Boeyens (Boeyens & van der Ryst 2014) and field surveys by Aukema (Aukema 1989; Huffman 1990, 2007) that remain unpublished because of his untimely death. On present evidence, sites in the low altitude foothills of the Waterberg have longer sequences of occupation than those on the highlands. Olieboomspoort (Fig. 1), on the Riet River, not far from Lephalale, is the best example of a low altitude site. Its deep sediments include stone assemblages from an ephemeral, undated, Earlier Stone Age (ESA) on bedrock (Mason 1962), followed by a long series of Middle Stone Age (MSA) occupations, one of which yielded a U-series/ESR (electron spin resonance) age estimate of 150 000±1400 (150±14 ka) years ago (Val et al. 2021). More recent Later Stone Age (LSA) occupations (Mason 1962; van der Ryst 2006) date to the last few thousand years and they include a large collection of Bambata ceramics that potentially originate from the first herder incursions into South Africa about 2000 years ago (Lander & Russell 2018). There are, until now, no records of ESA sites on the Waterberg highlands and the earliest archaeological sites presently known here contain MSA cultural material in rock shelters and in the open. Apart from Olieboomspoort, only one Waterberg shelter site, Red Balloon, has dated MSA occupations (with a weighted mean single grain OSL age of 96±4 ka ago) (Wadley et al. 2021) and it is thus important to obtain a better chronology for the entire sequence of occupation in the highlands. MSA sites are unlikely to be older than 300 ka ago or younger than 30 ka ago because this is the duration of the MSA presently known from elsewhere in Africa (Lombard et al. 2022). Assuming that some of the Waterberg MSA sites were as young as 30 ka ago, there still remains a curiously long gap in the occupation of the Waterberg plateau because LSA settlement on the plateau generally dates only to the last 1000 years, based on the preliminary work by van der Ryst in 1998. Notwithstanding this earlier observation, excavations in Kaingo Sheep Rock Shelter yielded OSL ages of about 4400 and 1860 years before present (Wadley et al. 2022). The Sheep Shelter extends van der Ryst's chronology slightly, but the site might be an exception because of its proximity to the reliable water supplies of the Mokolo River. We therefore speculate that the highlands were abandoned for environmental reasons that remain obscure until more dates and environmental proxies become available.

Understanding the gap in occupation and obtaining dates for the Waterberg sequence is a major research objective. First, however, we need to be sure that the gap in Waterberg occupation really exists, and we can only do this by dating several sites. The demographic movement into the Waterberg in the last 2000 years seems unprecedented elsewhere in South Africa, as is the extremely lengthy hiatus between MSA and LSA occupations. We targeted Woodstock Rocks as a site that might contribute to answering the research question.

Figure 1. Woodstock Rocks, Limpopo Province, Waterberg, together with other known archaeological sites in the area.

Woodstock Rocks

Woodstock Rocks are steep, west-facing sandstone cliffs above the Mokolo River (Fig. 2), on the farm Woodstock 161 KQ that is part of Kaingo Private Game Reserve in the Lephalale district of the Limpopo Province (24°02'52" S, 27°48'15" E) (Figs 1 & 2). The cliff bows to the river so the terrace hugging it is partly sheltered by a shallow rock overhang. The cliff terrace is about 30 m above the river, and it was used intermittently from the Stone Age to the Iron Age. We selected the site for excavation after visiting its rock art and observing ceramics and lithic artefacts on the terrace's surface. The cliff forming Woodstock Rocks has faded rock paintings over much of its lower surface and we call this painted area Woodstock Rocks Rock Art 1. About 10 m north of our datum peg (Fig. 2) is a high ledge (approximately 5 m above ground level) with relatively well-preserved paintings of an eland and several indeterminate antelope. This panel is named Woodstock Rocks Rock Art 2.

Several Waterberg Group rocks and minerals are suitable for knapping and examples of these were scattered on the surface of the site. The Mogalakwena Formation comprises sandstone, conglomerate and shale (Callaghan 1993). The conglomerate hosts pebbles and cobbles of cryptocrystalline silica. Volcanic rock, such as diabase, intruded the Waterberg sandstones and the resulting metamorphism of the sandstone produced quartzite, sometimes with veins of quartz where crystals can be found (Brandl 1996). Coarse-grained quartzite outcrops on the Woodstock Rocks cliff terrace. The Vaalwater Formation, the youngest part of the Waterberg succession, comprises a basin of deposits about 475 m thick, and no wider than 40 km (De Vries 1970, 1973; Jansen 1982; Callaghan 1993). This basin extends into part of the Kaingo Reserve and its margin is only a few kilometres from Woodstock. The Vaalwater Formation probably formed under shallow water (Jansen 1982), resulting in sediments that include fine-grained sandstone, siltstone and coarse-grained (originally termed 'gritty') sandstone (De Bruiyn 1971). Siltstones were regularly part of stone tool manufacture in the Waterberg (Wadley et al. 2016; Wadley et al. 2021; Wadley et al. 2022).

The southern part of the site (Fig. 2) has a very shallow ashy area close to the cliff face with mixtures of MSA and LSA tools and Bambata, Happy Rest, Diamant and Eiland facies ceramics, and beyond that is a water-eroded channel marked by small rock spall. The channel's slope suggests that artefacts washed from here to the talus slope where there are many stone tools, grindstones (SOM Figs 1 & 2) and fragments of pottery. The northern terrace has deeper sediments so this is where we elected to excavate.

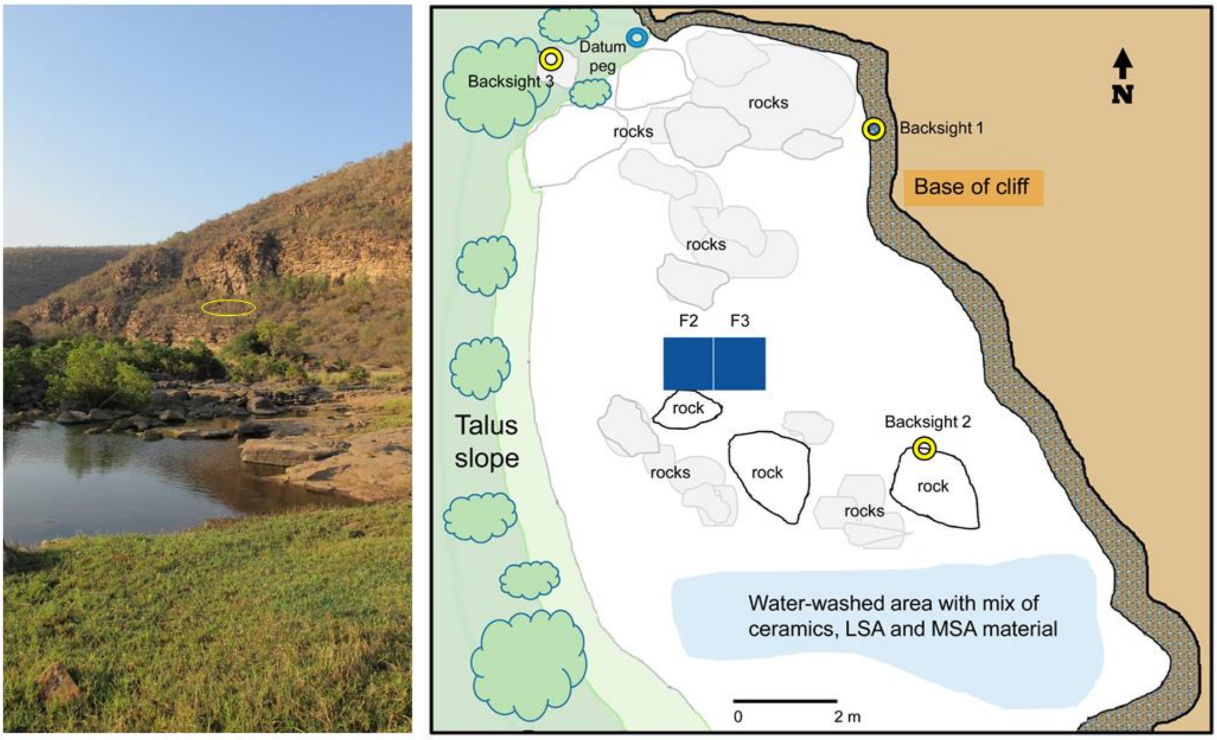

Figure 2. View of Woodstock Rocks (left, marked with a yellow oval) and site map (right). The dark blue squares labelled F2 and F3 mark the excavation (2x1 m). The datum peg and backsights are survey points for the total station readings. Woodstock Rocks Rock Art 1 is on the cliff illustrated here; Woodstock Rocks Rock Art 2 is north of the datum peg.

2. Methods

Botanical survey and seed study

No formal botanical survey was conducted, but trees and shrubs on the hillside and adjacent to the river were recorded. All excavated seeds were collected from the 1 and 2 mm sieves and were sorted into types. Seeds were not quantified because they have their origin in baboon faeces and are not archaeological inclusions. Nonetheless, their types are listed because they provide a record of edible fruits available in the area during the Holocene.

Rock art recording

The rock art at the site was recorded in February 2022, September/October 2022 and in January 2023. The site was photographed using Fujifilm X-T3 and Canon PowerShot G12 digital cameras. DStretch (Harman 2006) was later used to enhance many of the digital photographs, but many faded images were difficult to identify and we therefore decided against quantifying and tabulating the images. Detailed sketches were drawn of selected images and descriptive notes were recorded in the field and supplemented after viewing the digitally-manipulated images. Selected images were digitally traced and redrawn using Adobe Illustrator software. Photographs, digitally-enhanced images, and field sketches were used to ensure the maximum accuracy of the tracings and redrawings. Tracing from photographs is not ideal as subtle details may be missed and Dstretch introduces visual artefacts that can be misconstrued. Digital tracings should be checked at the rock face, but time constraints did not allow this.

Surface survey

The dripline, shallow deposit in the south of the site, and the talus slope were surveyed for ceramics, grindstones and any lithics that might provide information about use of the site through time. Ceramics were collected and drawn. Grindstones were photographed, counted and left at the site. Several surface lithics were photographed.

Below the cliffs, close to the Mokolo River, we found a ferricrete terrace with large lithics cemented in it. The proximity of this river terrace to the cliff terrace above it suggests that material from the higher terrace might periodically topple from the talus slope to the lower terrace. This suggestion is strengthened by the large number of artefacts on the talus slope and by the similarity of the artefacts found on the cliff terrace and those embedded in the river terrace ferricrete. The quartzite used on the cliff and at the river has the same range of textures (predominantly coarse-grained), and it is the same grey colour; in contrast, the quartzite that was exploited at another site, several kilometres distant from Woodstock Rocks, is fine-grained and is pinkish-brown.

Excavation

The excavation took place in September/October 2022 with SAHRA permit #3629. The cliff terrace in front of the rock art was carpeted with bidim geotextile to prevent dust from coating the rock art. A 2x1 m grid (squares F2 and F3), was aligned north, on the northern part of the terrace where there was space to excavate between the rock fall debris (Fig. 2). A Nikon Nivo 5C total station was used for piece plotting and site mapping. All worked stone over the size of 20 mm was x, y and z plotted with the total station. Standard archaeological techniques were applied: excavation followed natural stratigraphy and the Munsell Soil Colour Chart was used for all colour coding on dry sediment assessed in well-lit shade. Sieving of excavated sediment (through 1 mm and 2 mm nested screens) took place at the edge of the talus slope so that dust did not reach the paintings. After the excavation, the base of the trench was lined with geotextile, rocks, and sediment-filled biodegradable hessian sacks. The sacks were hidden with sieved, raked soil from the excavation.

Lithic analysis

Lithics were washed in cold water and coded by rock or mineral type. Pieces of particular interest that were heavily coated with a claylike patina were cleaned for 40 minutes in an ultrasonic cleaning tank with water and one drop of dishwasher liquid soap, heated to 60 degrees Celsius. Most lithics were made on local coarse-grained quartzite that is difficult to ‘read’, making knapping scars challenging to count. Lithics were first sorted into broad typological categories: core, whole flake (cortical or non-cortical, *Levallois*/pseudo-*Levallois*), broken flake, blade, retouched pieces (tools), and chips and chunks. Chips were sorted into two categories: those smaller than 10 mm and those between 10 and 20 mm. Cores were further subdivided into bipolar, single platform (with a separate blade category on single platforms), adjacent platform, opposite platform and those with radial flaking. Within the flake category, trimming flakes, preparation flakes and rejuvenation flakes were combined because it is impossible to separate them accurately (McNabb 2009).

Lithic measurements and statistical analysis

Length, breadth and thickness of all whole flakes were measured in mm with digital callipers. Non-cortical flakes on quartzite from layers Very Dark Greyish Brown, Dark Brown and Brown were selected for statistical analysis because of their large sample size, and to detect possible change through time. All outliers greater than the 1.5 interquartile range were removed and a one-way analysis of variance (ANOVA) was used to determine whether there were statistically significant differences in the mean length, breadth, length:breadth ratio, and thickness of the measured artefacts between stratigraphic units. The test was done using R4.2 and RStudio 2022.07.1 Build SS4. A Tukey's HSD post hoc test was run on thickness.

Coring for Optically Stimulated Luminescence (OSL) dating

To obtain OSL age estimates for the basal sediments, we retrieved three sediment cores in plastic tubes hammered into the sections of square F3. One core was removed from just above the rock fall and two from below it. The cores were sent to Professor Richard Roberts at the Earth Laboratory of Wollongong University in Australia accompanied by the Australian soil sampling permit 0006327625 and light-safe letter. The sediments were subjected to single grain OSL analysis in the Earth Laboratory.

Coring for palaeomagnetic analysis of ferricrete from the river terrace below Woodstock

Twelve core samples were collected from ferricrete from the river terrace below Woodstock Rocks using a portable, petrol-powered drill and oriented *in situ* with magnetic and sun compasses. Samples were prepared as 2.5 cm diameter cylindrical specimens, of which at least one per sample was demagnetised at the University of Johannesburg. One specimen was subjected to alternating field (AF) demagnetisation from 5 mT to 100 mT, but the method was ineffective at removing the specimen's remanence. All other specimens were initially subjected to low field-strength alternating field (AF) 'cleaning' steps of 2.5, 5, 7.5 and 10 mT using a Molspin, Ltd. 2-axis tumbling shielded demagnetiser, 2G Enterprises™ DC-4K vertical superconducting rock magnetometer (SRM). Hereafter, the specimens were fully thermally demagnetised in ~20 heating steps from 100-620°C using an ASC Scientific shielded furnace. Specimen remanence was measured using the SRM after each successive demagnetisation step. Magnetic components were identified from demagnetisation data via least squares analysis (Kirschvink 1980) using Paleomag 3.1b3 (Jones 2002).

3. Results

Modern vegetation on the Woodstock Rocks hillside and riverine route into the botanical reserve

The surface layers of the excavation were plant-rich with seeds and wood. The seeds seem mostly to have eroded from baboon faeces. As a result, they cannot inform us of human use of the plants. Nonetheless, the excavated seed collection provides a useful Holocene environmental record. *Grewia* (rosyntjie) seeds were the most common, but *Ziziphus mucronata* (buffalo-thorn) and *Sclerocarya birrea* (marula) seeds were also plentiful and other edible fruits were present too, such as *Bridelia mollis* (velvet sweetberry), *Mimusops zeyheri* (moepel), *Hexalobus monopetala* (shakama plum) and *Pappea capensis* (jacket plum). To compare excavated plant material with what is available in the modern environment, we conducted an informal survey of trees and shrubs in the areas that we walked and drove (SOM Table 1). Seed taxa present archaeologically, but not recorded in the survey, are likely growing locally. These are *Berchemia zeyheri* (red ivory), *Chaetacme aristata* (thorny elm), Cucurbitaceae (melons) and *Lannea* sp. (wild grape). The seed assemblage provides no evidence of any change in vegetation during the Holocene, and the absence of any seeds from lower layers precludes comparisons with periods before this.

Rock art

Paintings cover the rock face behind the excavation in the area we have called Woodstock Rocks Rock Art 1. Exposed to the elements, much of the art has deteriorated; thus, the motifs are visible only through close inspection or with the aid of Dstretch technology (SOM Fig. 3). The fine-line paintings, attributed to LSA hunter-gatherers (e.g., Eastwood & Eastwood 2006; Eastwood et al. 2010), are predominantly monochrome and primarily in red, and less frequently in yellow. Nearly all the images are animal and human figures. In a sheltered position on the far right of the overhang, remnants of two bichrome eland are visible, implying that more images using this method may have existed in the past (SOM Fig. 4). While we could not perform quantitative analysis, it is clear that animal images are most common. Most of the animal representations are of antelope, but due to the challenges posed by poor preservation, precise identification to species level is not attempted here. The two bichrome eland (one of which is illustrated in SOM Figure 4) were identified from their distinctive body shape and the distinctive manner of depiction. Two other animal paintings were recognised. The first is a small creature with a large, bushy tail and a feline-like head (Fig. 3). It potentially represents either a genet or a white-tailed mongoose. There are possible stripes on the tail, but these may be an artefact of the uneven rock surface. Confirmation of stripes would make a genet the more likely subject. The second image (Fig. 4) we identified as a wild dog, an identification supported by the renowned environmentalist and wildlife author, Clive Walker (pers. comm. June 2023).

Figure 3. Woodstock Rocks Rock Art 1: this small yellow animal with a bushy tail may be either a genet or a white-tailed mongoose. Image enhanced with Dstretch lds.

Numerous handprints, in yellow and red, are placed across the rock face of Woodstock Rocks Rock Art 1. Yellow handprints predominate and are, on average, smaller than those made in red. Two of the red hands are placed high on the rock wall well above the reach of even the tallest person. Paintings high above human reach are common in rock art sites, even in places where rock shelter sediment could not have been removed or deflated. It seems likely that artists sometimes used simple scaffolding made of branches to access out-of-reach rock surfaces. Faded white finger-paintings, similar to those attributed to initiation art produced by Iron Age farmers (Smith & van Schalkwyk 2002; Smith 2005), can be discerned. Of these, only one image is clearly representational (Fig. 5). Its elongated neck and legs have led us to identify it as a large game bird. Although the step in the rock below the bird's legs suggest that short legs were intended, thereby favouring a korhaan identification, the body shape is not correct for a korhaan. Instead, the bird's hunched back, pronounced breast, thickset thighs, long neck and the broken line between dewlap and tail suggest that the painting may represent an ostrich.

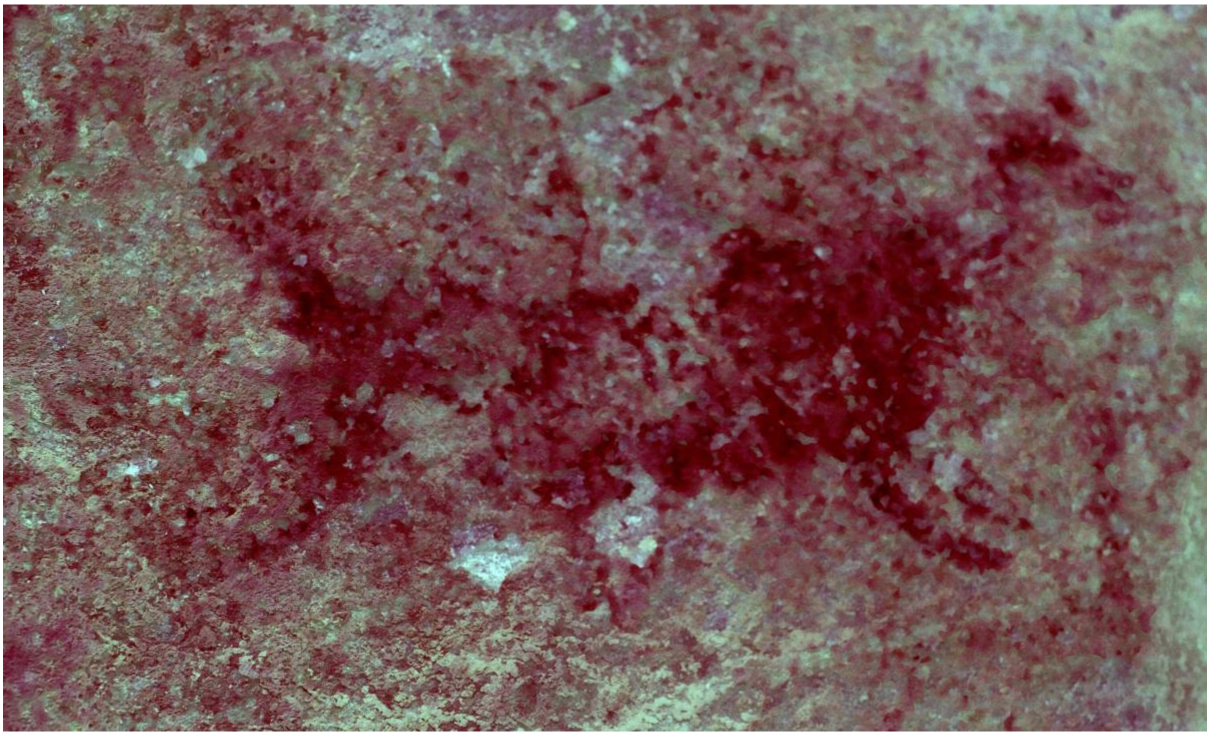

Figure 4. Woodstock Rocks Rock Art 1: enhanced image of a wild dog (Dstretch yre).

Figure 5. Woodstock Rocks Rock Art 1: redrawing of a white finger-painted bird with a long neck.

Approximately 10 m north of our datum peg (Fig. 2) there are additional rock paintings in a small recess that we have called Woodstock Rocks Rock Art 2. The art is approximately 5 m above ground level (SOM Fig. 5), but it is possible to climb rocks to access the recess. Eight antelope appear to be part of a single painting episode (Fig. 6). The largest, an eland, has a white head and legs and body outlined in white. No traces of other pigment are visible so we conclude that the body was never filled with pigment. In contrast, the other seven antelope are rendered in red with white outlines. The images in this recess have generally survived well, however, there is an accumulation of dust adhering to parts of the rock surface, obscuring certain features. The seven antelope are painted in a similar way, yet exhibit unique body shapes, heads and neck lengths.

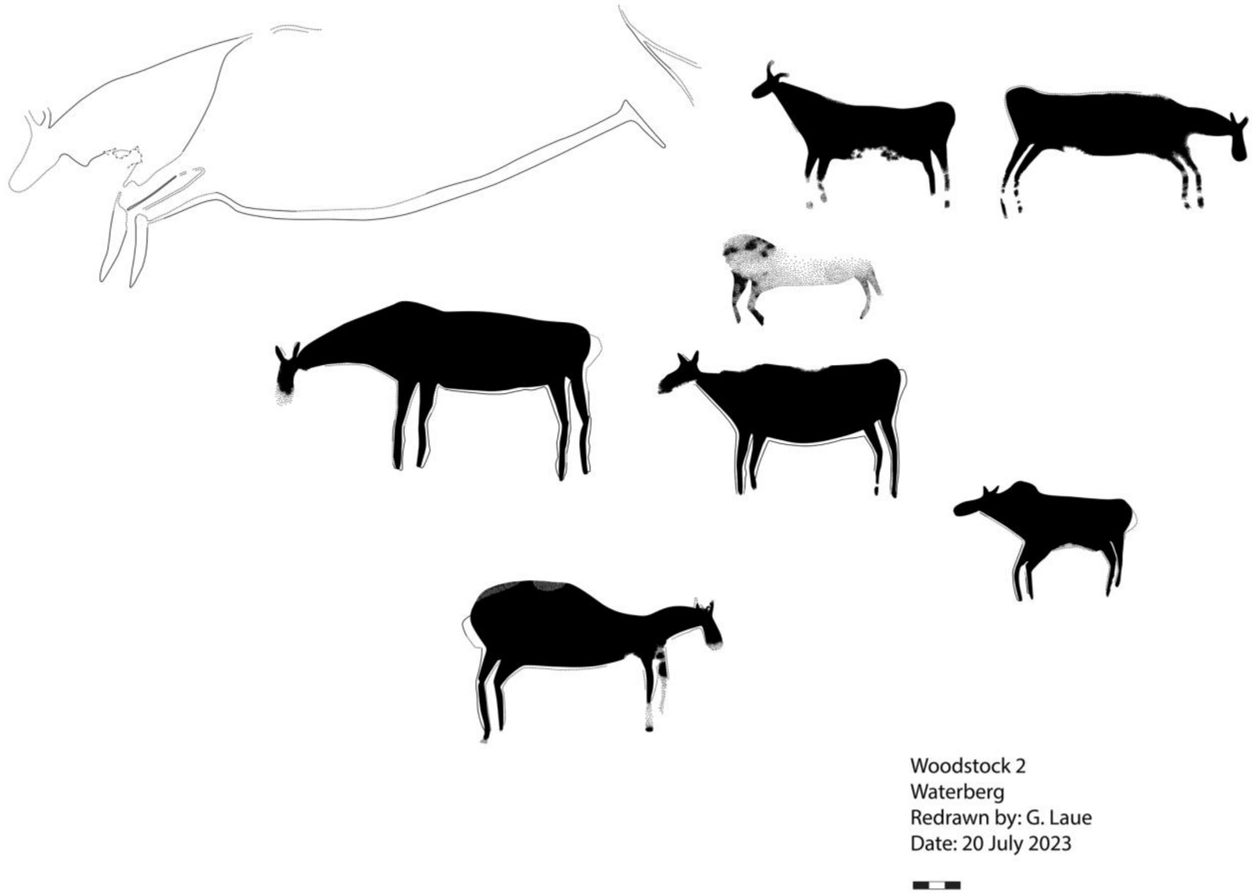

Figure 6. Woodstock Rocks Rock Art 2: redrawing of eight antelope in the small, high alcove north of the datum peg (black=red; white=white).

Surface observations

The southern area of the cliff terrace contains MSA lithics, including two bifacial points (Fig. 7), but there are also LSA lithics, such as thumbnail scrapers, many grindstones and some ceramics. A conflated palimpsest of surface material lies in shallow, ashy sediment on bedrock. This extends along spall-laden channel wash to the dripline and steep talus slope a few metres from the cliff face. Abundant finds on the talus slope demonstrate that rain periodically flushed artefacts over the edge and this supports our proposed link between the cliff terrace and river terrace. Potsherds include 2000-year-old Bambata ones – these are amongst the earliest ceramic types known in southern Africa and they may belong to pastoralists. The surface collection yielded decorated pieces from six different Bambata vessels. These and the Iron Age farmer vessels were probably left at the cliff during ritual proceedings. Iron Age ceramics, particularly from the Happy Rest, Diamant and Eiland facies, were also found on the surface near the cliff and on the talus slope (see Table 1 & Fig. 8).

The surface collection of ceramics totalled 84 sherds of which 66 were decorated and 18 undecorated. The excavation yielded six sherds of which three were decorated and three undecorated. The diagnostic vessels in the collection included 50 jars, 17 constricted jars and 13 bowls. The decorated sherds come from different vessels because their designs are not the same. Three Eiland facies bowls were burnished with red ochre on the outside and inside of the vessels. Tswana pottery is represented by a Letsibogo facies bowl sherd, which was burnished with graphite on the inside.

Fifty upper grindstones and six lower grindstones were found scattered over the site surface (SOM Figs 1 & 2), particularly on the talus slope in the southern area that we did not excavate because of the shallow sediments and artefact admixture. These surface artefacts were left at the site. Occasionally, grindstones have red stains on them that are visible to the naked eye, and these stones may have been used to process iron oxides (ochre) to make red powder. Microscopic analysis would undoubtedly reveal more ochre traces. A few of the upper grindstones have percussion marks on them and they may have served as hammerstones as well as grindstones. They were not examined in detail because microscopic examination in the laboratory is required and we did not want to remove material that was not part of the excavation trench. It is likely that the grindstones were recycled (and even re-purposed) through the ages, so their context is uncertain.

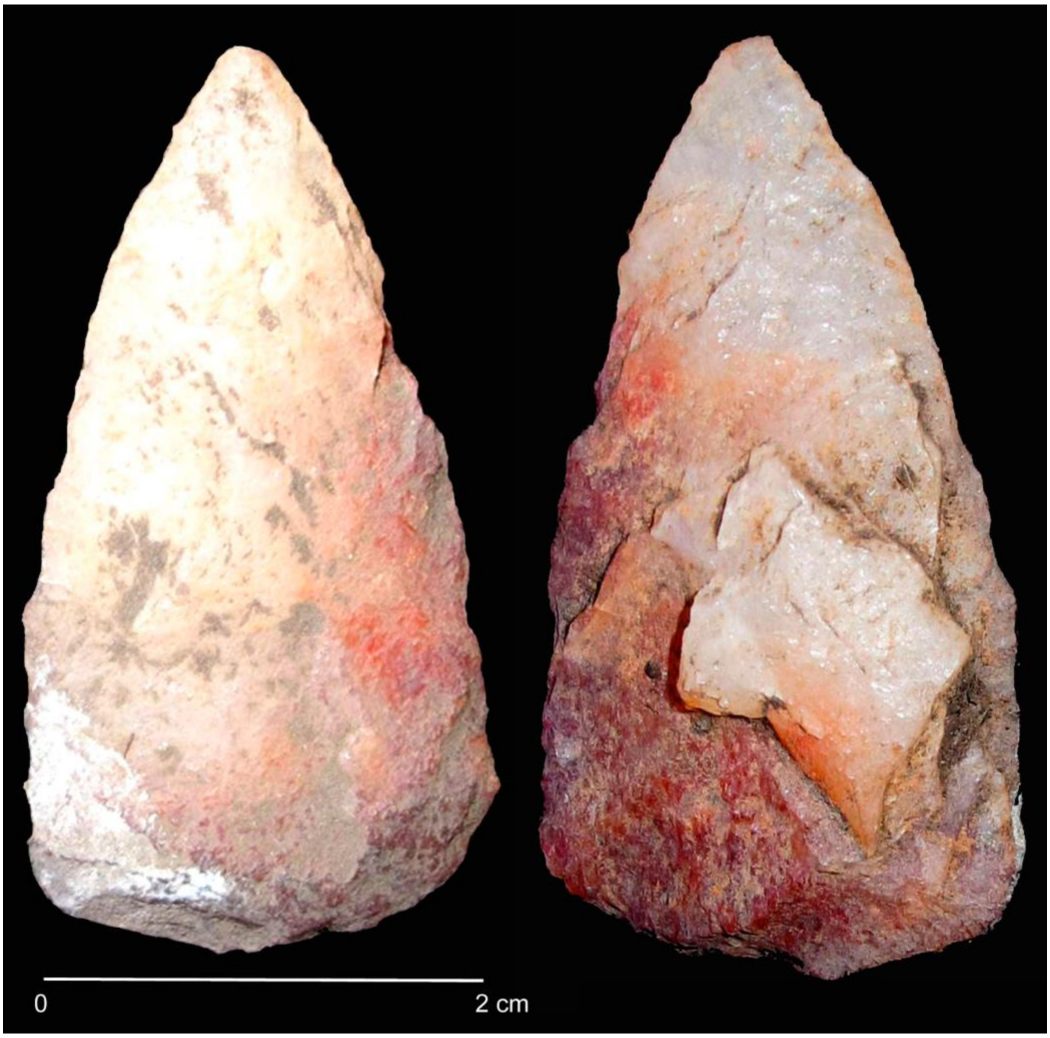

Figure 7. Both faces of an agate bifacial point found on the unexcavated surface, south area.

Table 1. Ceramic sherds from various facies recovered from the Woodstock Rocks surface collection and excavation.

Location	Facies	Jars	Constricted jars	Bowls	Indeterminate	Total
Surface collection	Bambata	3	2	1	0	**6**
	Happy Rest	4	0	0	0	**4**
	Diamant	2	0	0	0	**2**
	Eiland	32	11	4	7	**54**
	Undecorated	9	3	6	0	**18**
Excavation	Eiland	0	1	1	0	**2**
	Letsibogo	0	0	1	0	**1**
	Undecorated	0	0	0	3	**3**
	Total	**50**	**17**	**13**	**10**	**90**

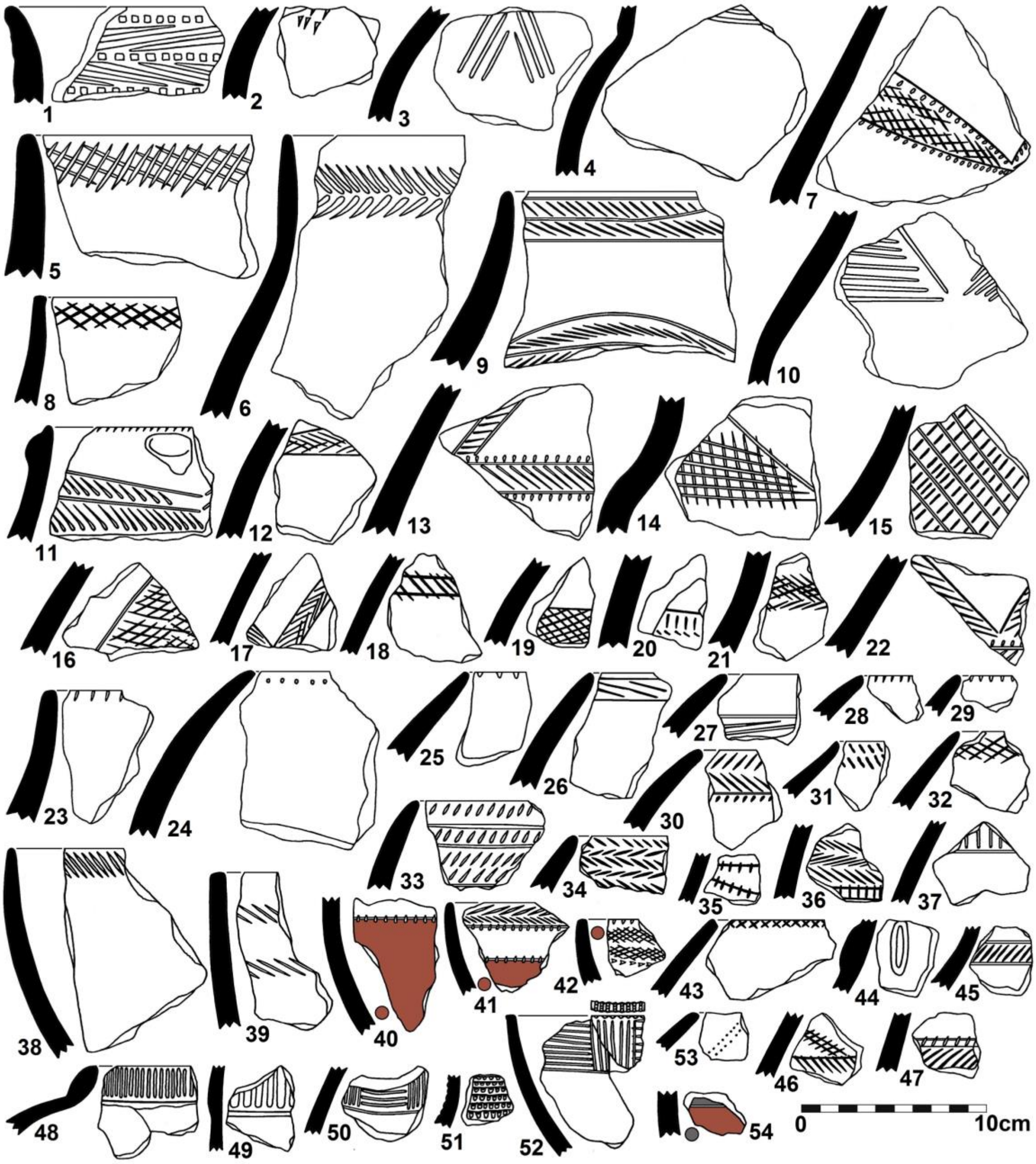

Figure 8. Decorated ceramics retrieved during the surface collection (sherds 1-38, 40-42, 44-53) and excavation (sherds 39, 43, 54). They represent the Happy Rest facies (1-4); Diamant facies (5, 6); Eiland facies (7-47); Bambata facies (48-53) and Letsibogo facies (54) pottery (grey dot=grey colour inside; red dot=red ochre colour inside).

The excavation

The excavation trench was placed where sediment appeared to have some depth (Figs 2 & 9). In addition to recording the volume of deposit, Table 2 lists the bucket points recorded by the Nikon total station for each layer and its associated plans. Below the organic-rich surface layers that yielded 59% of the total deposit volume (Table 2), the sediments were filled with rock spalls and rock fall (Fig. 9). The seeds and other plant material in Surface were often enclosed in baboon faeces. A few rodent bones were also found in Surface. The basal layer, Brown, which has the richest lithic artefact content (and highest volume density of artefacts), produced only 6% of the excavated sediment (Table 2) and the stratigraphy (Fig. 9) implies that the sediment that we encountered in Brown was trapped in hollows in the bedrock. The tightly packed lithics with a little sediment cushioning them suggests the sort of deflated ‘pavement’ that occurs when sand and organic material are flushed out.

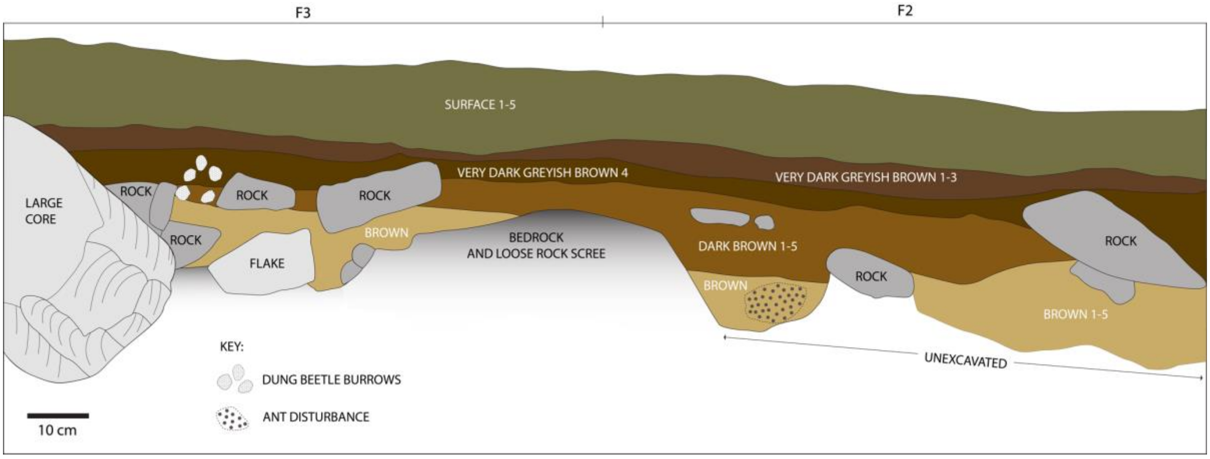

Figure 9. Woodstock Rocks stratigraphy of the south wall. Rockfall appears to predate and postdate the accumulation of lithics and sediment in Brown. Note the slope of the sediment (towards the talus) and the dung beetle burrows and ant disturbance that is likely to have allowed some MSA and LSA artefacts to penetrate the older layers.

There was some artefact mixing between unrelated technologies in square F2, which has its west section close to the dripline where artefacts might have been flushed in or out of the site by water. Nonetheless, the inclusion of LSA lithics in the trench was small and lithics that were unequivocally MSA were also scarce. Notwithstanding the bifacial points found on the surface in the south of the site, no such artefacts were recovered from the excavation and few ceramic sherds were found in the trench. Because this was an exploratory excavation, we did not conduct fabric analysis, but we observed artefacts standing on edge, implying disturbance, and the terrace surface slants towards the talus so that artefacts are encouraged to move downslope. The sediment slope is clearly visible in the section (Fig. 9).

Table 2. Woodstock Rocks stratigraphy, bucket points (BP) and litres of sediment. The volume of sediment is presented in litres because the excavation buckets are calibrated in litres.

Layer	Plan	BP F2	BP F3	Litres F2	Litres F3	Litres total
Surface	1	150	55	46	34	**80**
Surface	2	291	200	42	36	**78**
Surface	3	438	331	48	39	**87**
Surface	4	504	382	41	30	**71**
Surface	5	597	459	50	24	**74**
Surface total						**390 (59%)**
Very Dark Greyish Brown (VDGB)	1 & 2	622	525	23	24	**47**
Very Dark Greyish Brown (VDGB)	2	0	552	0	28	**28**
Very Dark Greyish Brown (VDGB)	3	696	662	21	22	**43**
Very Dark Greyish Brown (VDGB)	4	758	724	16	18	**34**
VDGB total						**152 (23%)**
Dark Brown	1	797	767	13	6	**19**
Dark Brown	2	847	809	10	5	**15**
Dark Brown	3	1035	1052	14	3	**17**
Dark Brown	4	1093	0	7	0	**7**
Dark Brown	5	1105	0	1	0	**1**
Dark Brown Rockfall	0	869	867	3	15	**18**
Ant's nest under rock 1	0	868	0	1	0	**1**
Dark Brown total						**78 (12%)**
Brown	1	1222	900 & 1159	4	12	**16**
Brown	2	1259	1278	8	3	**11**
Brown	3	1296	0	4	0	**4**
Brown	4	1303	0	12	0	**12**
Brown total						**43 (6%)**
Total litres from all layers						**663 (100%)**

To estimate ages for the oldest Woodstock occupations, we retrieved three sediment cores (SOM Fig. 6), one from just above the rock fall and two below it. The sediment was processed by single grain optically stimulated luminescence (OSL) dating in Australia at the Earth Laboratory of Wollongong University, but unfortunately it was not possible to obtain an age from the cores because of the loss of integrity caused by mixing of grains in the sediment.

Under the rockfall, in layer Brown (Fig. 9), we recovered large lithics that were made on site from the quartzite blocks that lie close to the cliff. We now describe these and the other lithics from the excavation.

Lithic analysis

The Woodstock Rocks assemblage is flake-rich with relatively few retouched pieces (Table 3). Points are rare, and even the most common formal tools – scrapers and notches – are rather scarce. Amongst the broken tools is the tip of a quartzite handaxe (Fig. 10.1) and the base of a bifacial tool that may have been a small handaxe (Fig. 10.3). A few large bifacial trimming flakes are also present (Fig. 11.2) and some whole and broken flakes have twisted profiles. Cores are most prevalent in layer Brown (Tables 3 & 4), and the largest cores were excavated from this layer. The highest volume density of lithics occurs in Brown, indeed the volume density is at least 10 times that of the other three layers (Table 3). One giant core that seems to be a single platform core with several removals (not listed in the table) is wedged into the F3 east section wall (of layer Brown) and was not removed from the trench (Fig. 9). Casual and single platform cores are most common, but bipolar cores are rare (Table 4). Giant cores in the form of grey quartzite boulders are present on the cliff terrace and large prepared cores were observed near the talus slope (e.g., Fig. 12.2). Radial flaking of cores is evident from some by-products, as well as *Levallois* and pseudo-*Levallois* flaking. Few cores showed evidence of elongated flake removals and this is consistent with the presence of rare elongated flakes, but many short, wide ones (e.g., Fig. 12.1).

Table 3. Frequencies of cores, flakes and retouched pieces. Volume densities of the pieces are calculated as the number of pieces per litre of sediment (VDGB=Very Dark Greyish Brown).

Layer	**Core**	**Bipolar core**	**Cortical flake**	**Whole flake**	**Broken cortical flake**	**Broken flake**	**Bifacial point**	**Unifacial point**	**Scraper**	**Notch**	**Other tool**	**Broken tool**	**All retouched pieces**
Surface 1-2	5	0	5	17	3	56	0	0	2	2	0	1 scraper	0
Surface 3-4	7	0	4	21	1	64	0	1 broken	1	1	2	1	11
Lithic/litre (163 litres)	**0.07**	**0**	**0.06**	**0.23**	**0.02**	**0.74**	**0**	**<0.01**	**0.02**	**0.02**	**0.01**	**0.01**	**0.07**
VDGB 1-2	3	0	4	15	2	28	0	0	2	1	2	0	3
VDGB 3-4	12	1	8	27	11	53	0	0	3	3	1	1	0
Lithic/litre (152 litres)	**0.09**	**<0.01**	**0.08**	**0.28**	**0.09**	**0.53**	**0**	**0**	**0.03**	**0.03**	**0.02**	**<0.01**	**0.02**
Dark Brown 1-3	9	1	28	32	6	61	0	0	3	0	0	1	10
Dark Brown 4-5	3	2	2	6	5	64	1	1	2	2	0	0	0
Lithic/litre (78 litres)	**0.15**	**0.04**	**0.38**	**0.49**	**0.14**	**1.60**	**0.01**	**0.01**	**0.06**	**0.03**	**0**	**0.01**	**0.13**
Brown 1	10	1	36	60	8	127	0	0	4	3	4	4	0
Brown 2	7	0	7	12	15	78	0	0	1	1	0	4	0
Brown 3-4	8	0	0	71	0	101	0	0	0	1	1	5+1 scraper	29
Lithic/litre (43 litres)	**0.58**	**0.02**	**1.00**	**3.33**	**0.53**	**7.12**	**0**	**0**	**0.12**	**0.12**	**0.12**	**0.33**	**0.67**
Grand total (all layers)	**64**	**5**	**94**	**261**	**51**	**632**	**1**	**2**	**18**	**14**	**10**	**18**	**53**

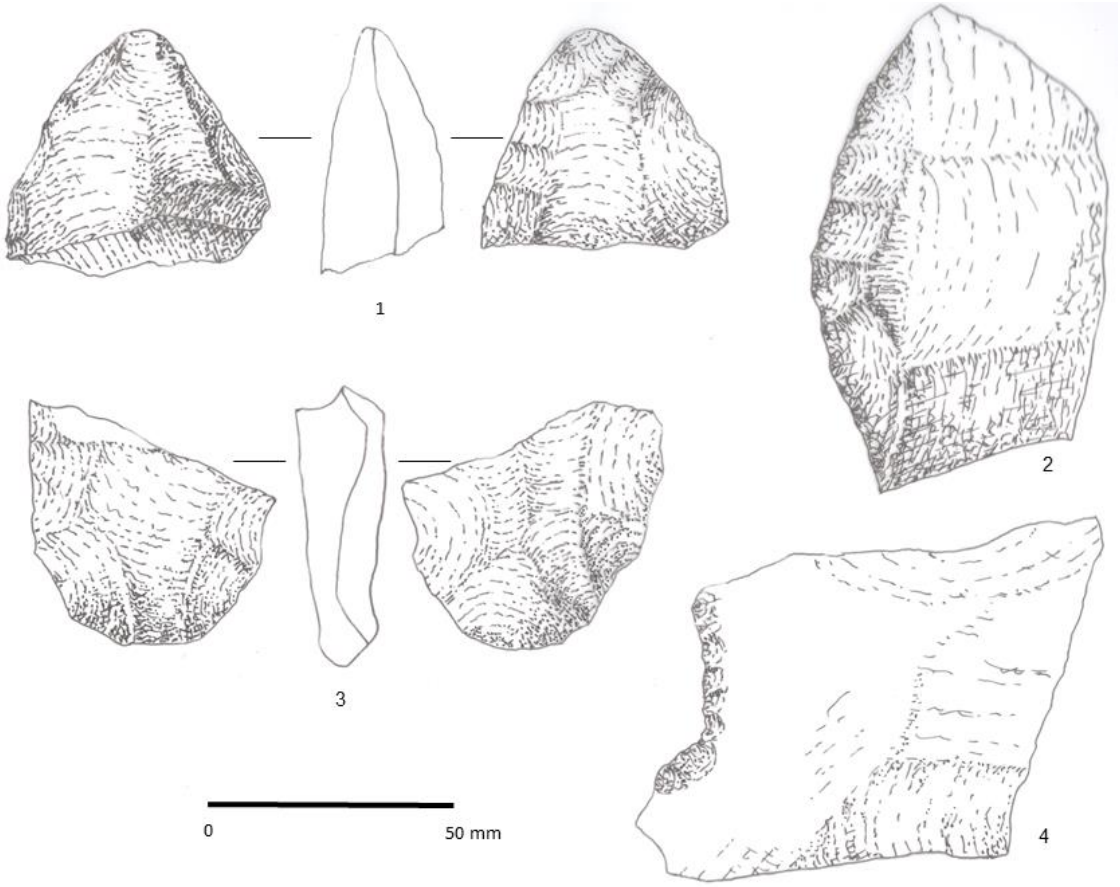

Figure 10. Formal tool sample. 1) Broken tip of handaxe: #874, F3 Brown 1; 2) scraper: #683, F2 VDGB 3; 3) broken base of handaxe: #1281, F2 Brown 3; 4) notch: #1141, F2 Brown 1 (where 1, 3, 4=quartzite; 2=sandstone).

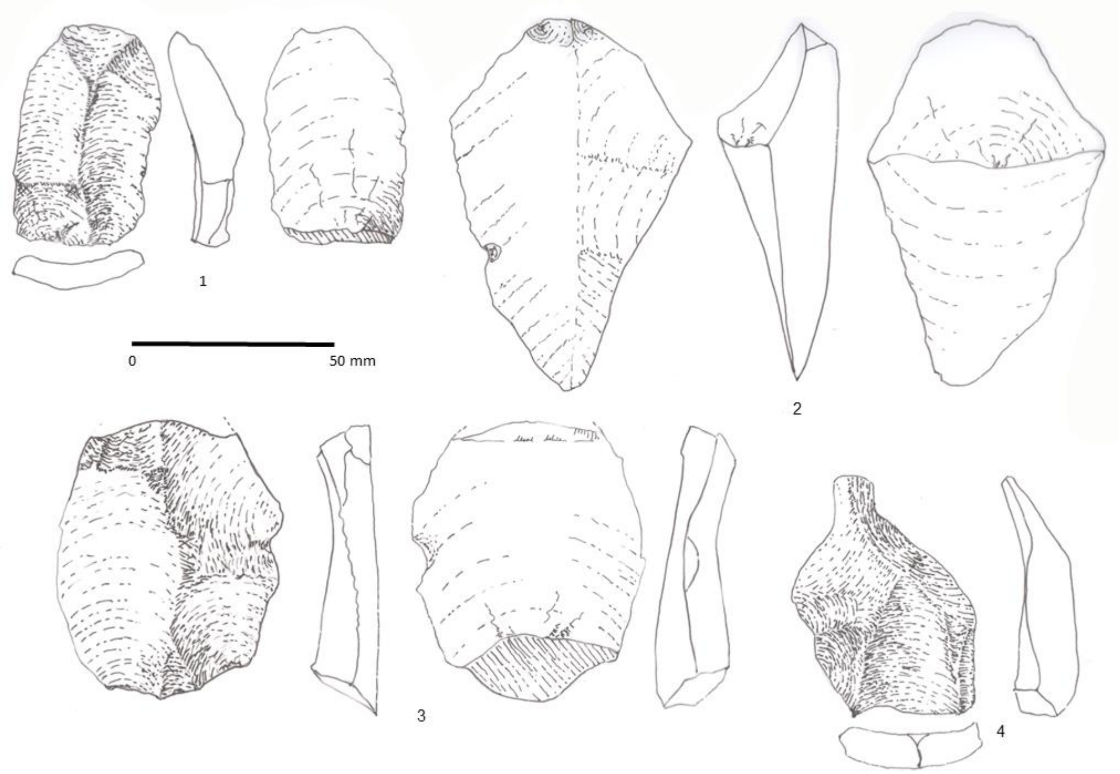

Figure 11. Various quartzite flake types from layer Brown. 1) #872, F3 Brown 1; 2) #897, F3 Brown 1; 3) F2 Brown 4 (not plotted); 4) #1285, F2 Brown 3.

Table 4. Woodstock Rocks core classification (where indet.=indeterminate; p.=platform; DB=Dark Brown; VDGB=Very Dark Greyish Brown). Two blade cores were identified, showing reduction from a single platform along the long axis of the core.

Layer	**Casual/indet.**	**Single p.**	**Adjacent p.**	**Multiple p.**	**Opposed p.**	**Radial**	**Prepared**	**Blade**	**Bipolar**	**Broken**	**Total**
Surface 1	2	1	0	0	1	0	0	0	0	0	**4**
Surface 2	1	0	0	0	0	0	0	0	0	0	**1**
Surface 3	1	0	0	0	0	0	0	0	0	1	**2**
Surface 4	1	3	0	0	0	0	0	1	0	0	**5**
Surface 5	0	0	1	0	0	0	0	0	0	0	**1**
VDGB 1-2	0	0	2	0	0	0	1	0	0	0	**3**
VDGB 3	2	1	0	0	0	0	0	0	1	0	**4**
VDGB 4	1	2	1	0	0	1	1	0	0	2	**8**
DB 1	0	0	0	1	0	0	0	0	0	1	**2**
DB 2	0	3	0	0	0	0	0	0	0	0	**3**
DB 3	2	2	0	0	0	0	0	0	1	0	**5**
DB 4	0	2	0	0	0	0	0	1	2	0	**5**
Brown 1	3	1	2	1	2	0	1	0	1	0	**11**
Brown 2	5	1	0	0	0	1	0	0	0	0	**7**
Brown 3	2	1	0	0	0	0	0	0	0	2	**5**
Brown 4	1	1	0	0	0	0	0	0	0	1	**3**
Total	**21**	**18**	**6**	**2**	**3**	**2**	**3**	**2**	**5**	**7**	**69**

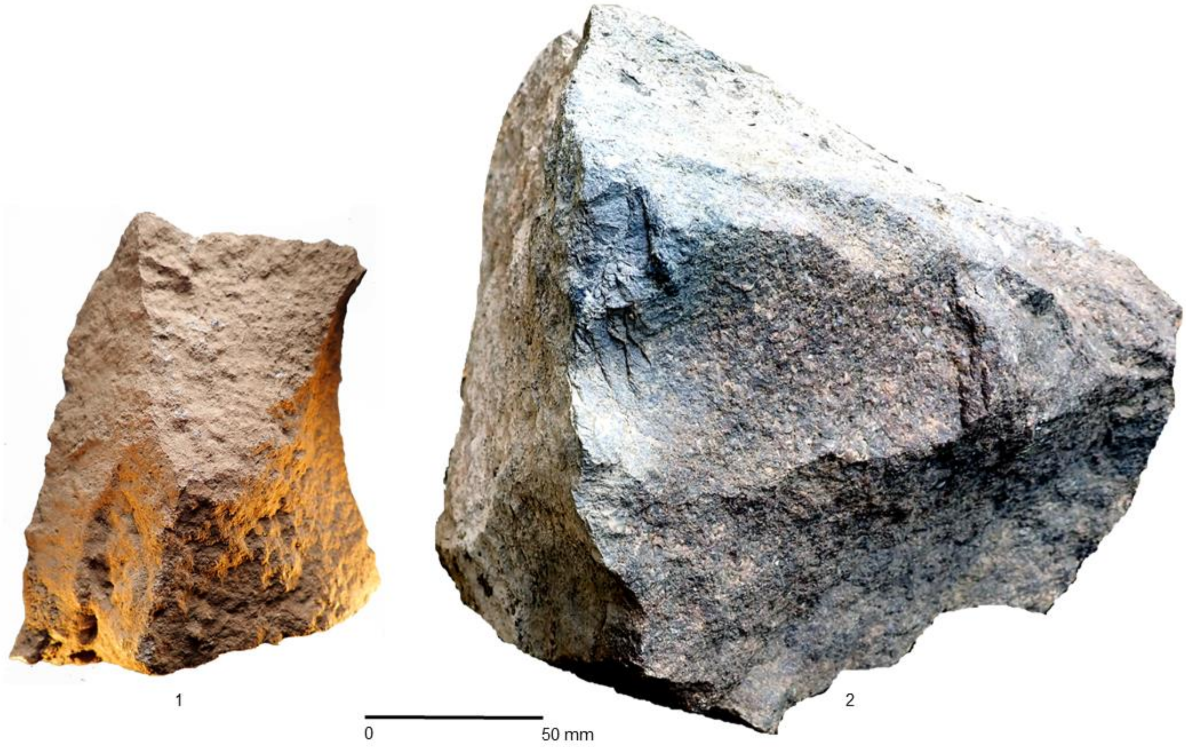

Figure 12. Woodstock Rocks quartzite flake and core. 1) Flake: F3 Brown 1; 2) core: Surface find. Note the clay-rich patina on the flake.

Almost all (96%) Brown cores are quartzite (Table 5; Fig. 13); 98% of Brown cortical flakes and 95% of broken flakes are also quartzite, followed by 91% of whole, non-cortical flakes (Table 5; Fig. 13). The relationship between quartzite core and flake percentages may imply that relatively few large flakes were considered suitable for further shaping. We think that large flakes were probably the desired blanks for making other products. Furthermore, the scarcity on the cliff terrace of LCTs, or fragments of them, suggests that prized pieces were removed from the cliff terrace for use elsewhere. The presence of some LCTs (SOM Fig. 8) on the river terrace tends to support the interpretation of off-site transport of blanks, albeit close by.

Although there are only five siltstone cores and four cortical flakes, there are a great many siltstone chips (Table 5). Siltstone chips smaller than 10 mm comprise only 8% of chips in Brown (80% of the chips in Brown are quartzite), but 39% in Very Dark Greyish Brown (Fig. 13).

Table 5. Distribution of rock types among retouched pieces, cores, flakes and chips.

Typology and raw materials		Surface 1-2	Surface 3-5	**Total**	Percentage	VDGB 1-2	VDGB 3-4	**Total**	Percentage	Dark Brown 1-3	Dark Brown 4-5	**Total**	Percentage	Brown 1	Brown 2	Brown 3-4	**Total**	Percentage	**Grand total**
Retouched pieces	Quartzite	3	2	**5**	71	3	4	**7**	70	3	5	**8**	89	9	1	2	**12**	80	**32**
	Siltstone	1	0	**1**	14	0	1	**1**	10	0	0	**0**	0	2	1	0	**3**	20	**5**
	Other	0	1	**1**	14	0	2	**2**	20	0	1	**1**	11	0	0	0	**0**	0	**4**
Broken retouched pieces	Quartzite	1	2	**3**	100	1	0	**1**	33	0	0	**0**	0	4	4	4	**12**	86	**16**
	Siltstone	0	0	**0**	0	1	1	**2**	77	0	0	**0**	0	0	0	2	**2**	14	**4**
	Other	0	0	**0**	0	0	0	**0**	0	1	0	**1**	100	0	0	0	**0**	0	**1**
Cores	Quartzite	2	5	**7**	58	4	7	**11**	79	0	1	**1**	20	9	7	8	**24**	96	**43**
	Siltstone	1	1	**2**	17	1	0	**1**	7	0	2	**2**	40	0	0	0	**0**	0	**5**
	Other	2	1	**3**	25	0	2	**2**	14	0	2	**2**	40	1	0	0	**1**	4	**8**
Cortical flakes	Quartzite	4	2	**6**	67	2	5	**7**	70	26	2	**28**	93	35	7	0	**42**	98	**83**
	Siltstone	0	2	**2**	22	1	0	**1**	10	1	0	**1**	3	0	0	0	**0**	0	**4**
	Other	1	0	**1**	11	1	1	**2**	20	1	0	**1**	3	1	0	0	**1**	2	**5**
Whole flakes	Quartzite	13	16	**29**	76	9	18	**27**	64	31	1	**32**	86	50	12	63	**125**	91	**213**
	Siltstone	3	5	**8**	21	4	7	**11**	26	1	3	**4**	11	5	0	6	**11**	8	**34**
	Other	1	0	**1**	3	2	2	**4**	10	0	1	**1**	3	0	0	2	**2**	1	**8**
Broken flakes	Quartzite	44	41	**85**	69	17	38	**55**	59	59	48	**107**	79	124	89	100	**313**	95	**560**
	Siltstone	8	12	**20**	16	8	17	**25**	26	7	20	**27**	20	10	4	0	**14**	4	**86**
	Other	7	12	**19**	15	5	9	**14**	15	1	1	**2**	1	1	0	1	**2**	1	**37**
Chips 10-20 mm	Quartzite	48	57	**105**	55	44	39	**83**	40	126	161	**287**	63	378	256	393	**1027**	82	**1502**
	Siltstone	34	33	**67**	35	50	58	**108**	52	41	87	**128**	28	76	50	38	**164**	13	**467**
	Quartz	6	13	**19**	10	3	5	**8**	4	7	26	**33**	7	13	11	4	**28**	2	**88**
	Other	0	1	**1**	1	8	0	**8**	4	2	7	**9**	2	37	0	0	**37**	3	**55**
Chips <10 mm	Quartzite	27	19	**46**	24	21	34	**55**	18	53	97	**150**	27	370	234	3006	**3610**	80	**3861**
	Siltstone	22	29	**51**	26	52	70	**122**	39	56	112	**168**	31	104	129	147	**380**	8	**721**
	Quartz	36	51	**87**	45	60	72	**132**	42	79	108	**187**	34	91	67	76	**234**	5	**640**
	Other	5	4	**9**	5	2	2	**4**	1	11	34	**45**	8	20	14	255	**289**	6	**347**

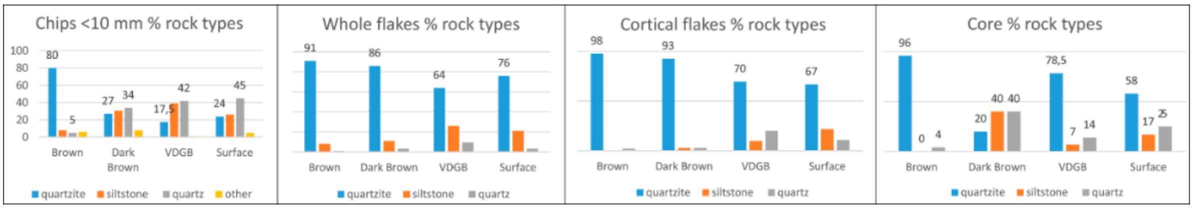

Figure 13. Woodstock Rocks percentages of quartzite, siltstone, quartz and other rocks in the chip, whole non-cortical flake, cortical flake and core categories. Whereas quartzite is most common amongst flakes and cores, this is not the case amongst chips smaller than 10 mm in layers other than Brown.

Quartzite flakes are longer, wider and thicker than siltstone flakes (Tables 6 & 7). Measurements of whole quartzite flakes (Table 6) suggest that the non-cortical quartzite flakes from Brown might be larger than their equivalents in the other layers, yet the one-way ANOVA showed no significant statistical differences between group means for length (F[2.154]=2.096, p=0.126), breadth (F[2.160]=2.588, p=0.078) and the length:breadth ratios (F[2.169]=2.506, p=0.085) in layers Brown, Dark Brown and Very Dark Greyish Brown. A statistically significant difference between the group means was, however, shown for thickness (F[2.158]=6.322, p=0.0023). The Tukey's HSD post hoc test showed that the mean thickness of non-cortical flakes in Brown was different from that in both Dark Brown and Very Dark Greyish Brown (Table 8; Fig. 14). Surface flakes were excluded from the test because of the small sample size.

Table 6. Mean measurements in mm for quartzite whole flakes (cortical and non-cortical) from all layers (with plans merged), including length, breadth, length:breadth ratios (L:B) and thickness. Ranges are presented in parentheses below the means.

Layers	**N (non-cortical flakes)**	**Length**	**Breadth**	**L:B**	**Thickness**
Surface	26	32.57 (14.2-86.3)	28.01 (7.5-82.6)	1.29 (0.4-2.7)	11.21 (2.6-49.4)
VDGB	26	37.91 (15.9-184.5)	34.83 (11.8-143.3)	1.14 (0.5-2.3)	10.41 (3.5-68.3)
Dark Brown	49	33.76 (11.8-104.2)	22.82 (7.9-59.0)	1.55 (0.6-3.1)	8.68 (3.4-26.4)
Brown	103	41.01 (15.3-122.3)	32.04 (9.0-103.7)	1.41 (0.5-2.5)	12.31 (3.5-41.8)
Layers	**N (cortical flakes)**	**Length**	**Breadth**	**L:B**	**Thickness**
Surface	6	42.85 (17.6-70.4)	33.35 (12.7-78.7)	1.50 (0.7-2.3)	12.48 (4.7-30.2)
VDGB	7	41.39 (23.9-68.0)	27.54 (18.2-43.2)	1.49 (1.0-1.7)	9.01 (5.8-18.2)
Dark Brown	39	31.41 (8.7-66.6)	27.46 (12.4-75.8)	1.25 (0.4-2.2)	9.10 (4.0-17.8)
Brown	73	33.57 (12.2-103.6)	28.83 (8.9-125.1)	1.23 (0.5-2.3)	9.50 (3.4-37.8)

Table 7. Mean measurements in mm for siltstone whole flakes (non-cortical) from all layers (with plans merged), including length, breadth, length:breadth ratios (L:B) and thickness. Ranges are presented in parentheses below the means.

Layers	**N (non-cortical flakes)**	**Length**	**Breadth**	**L:B**	**Thickness**
Surface	9	29.28 (20.0-43.0)	20.52 (11.7-33.0)	1.50 (0.8-2.3)	6.32 (3.3-16.8)
VDGB	13	25.44 (13.4-39.5)	21.90 (8.4-55.0)	1.34 (0.6-2.3)	6.82 (1.5-13.4)
Dark Brown	13	23.49 (14.9-31.6)	20.11 (10.2-34.3)	1.28 (0.6-2.4)	5.12 (2.8-8.7)
Brown	8	29.94 (15.7-41.5)	21.26 (12.5-33.0)	1.35 (0.5-2.8)	5.35 (3.1-9.2)

Table 8. Statistical differences between mean thickness of non-cortical flakes in Brown, Dark Brown and Very Dark Greyish Brown (VDGB).

Layers	**Dark Brown**	**VDGB**
VDGB	p=0.9946	X
Brown	p=0.00647	p=0.03905

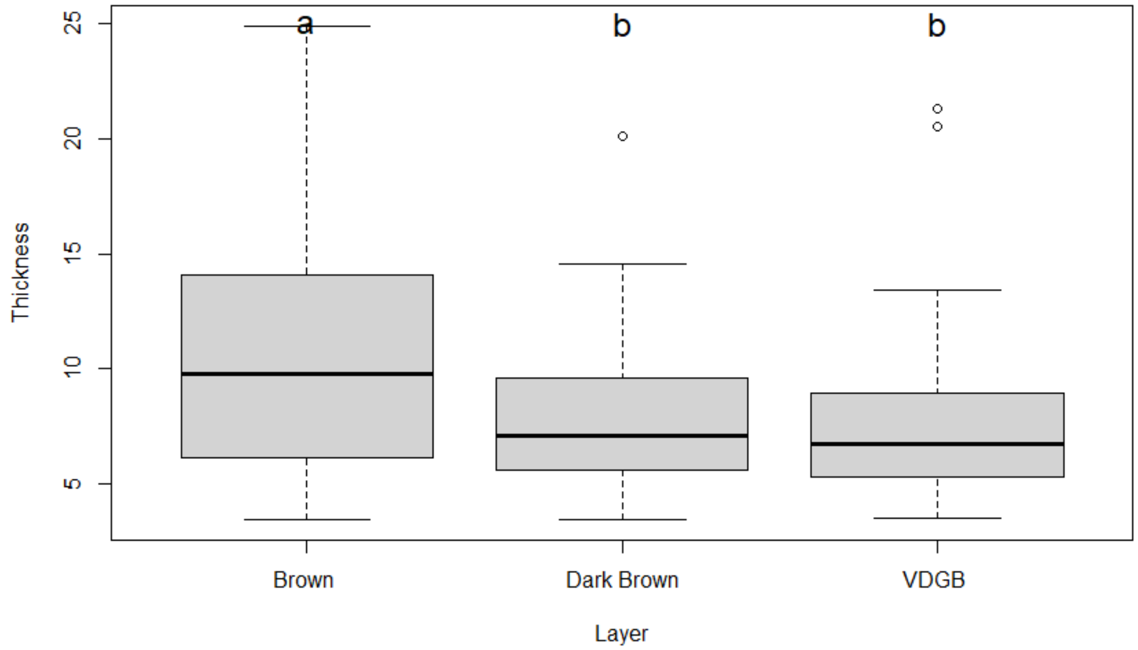

Figure 14. Box plot for thickness of non-cortical, quartzite flakes from layers Brown, Dark Brown and Very Dark Greyish Brown (VDGB). The a and b show which groups are statistically different from each other.

Lithics larger than 2 cm were point plotted with the total station and mapping examples are in Figures 15 and 16. The figures show that there are no >2 cm artefacts in the rubble plotted around the rocks. This suggests that the channels of rubble represent areas of wash.

Lithics observed (not excavated) next to the Mokolo River, either eroding from, or embedded in the ferricrete terrace included large quartzite flake blanks, handaxes and broken LCTs, and giant scrapers (SOM Figs 7-9).

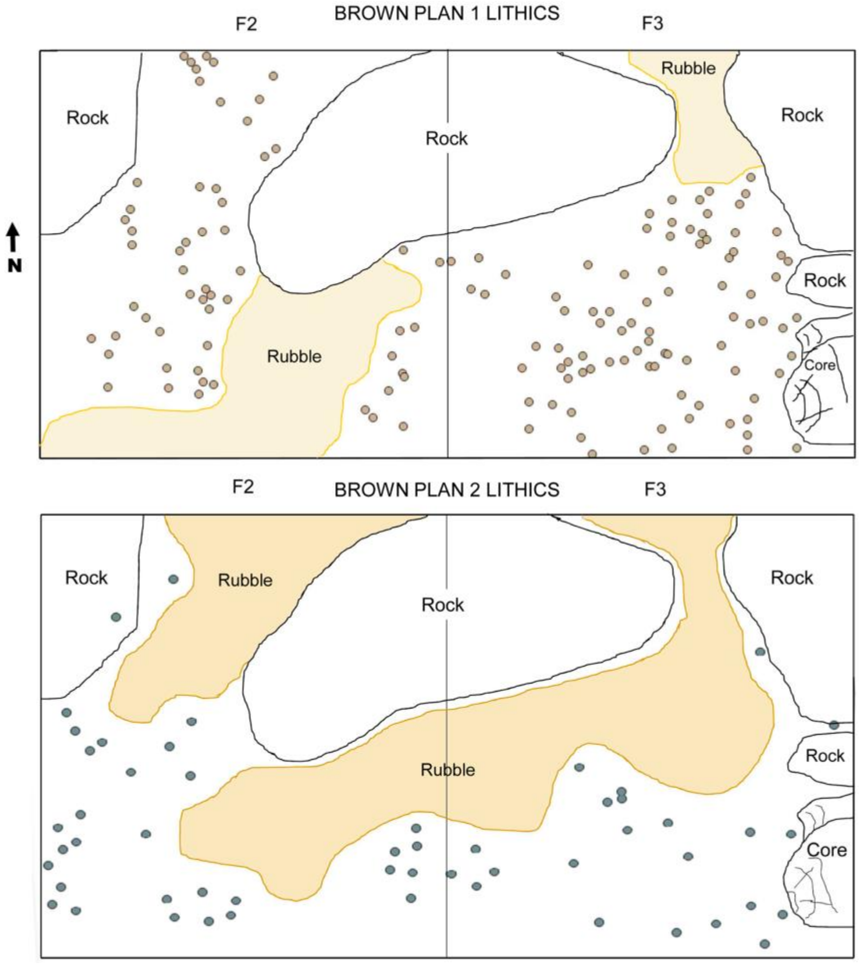

Figure 15. Woodstock Rocks layers Brown 1 and Brown 2: distribution of stone artefacts >2 cm (circles) between the rock fall and rocky rubble. In the south-east corner of F3 there is a large quartzite core from which flakes have been removed. Each square is one metre.

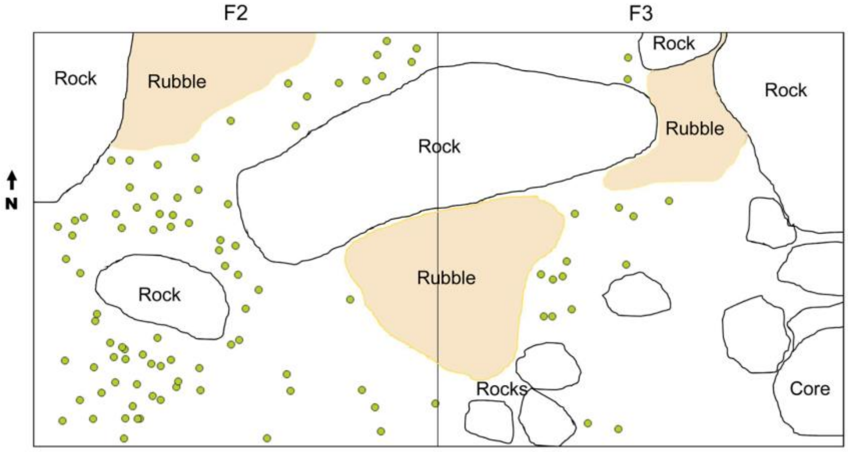

Figure 16. Woodstock Rocks layer Dark Brown, plan 3: distribution of stone artefacts (circles). Rockfall and rubble appeared in this plan in square F3 where there were fewer stone tools >2 cm than in square F2. Each square is one metre.

Palaeomagnetic results

The natural remanence of specimens is dominated by northerly and upward directed magnetisation, which is similar to the present-day geomagnetic field at the sampling locality (Fig. 17; SOM Figs 10 & 11). Two specimens yield inconsistent results. This is likely due to an error in orientation during sampling and their results are not further considered. Nine specimens displayed north-up components located at 354.4° declination and -43.0° inclination with a 95% probability (α_{95}) of 12.9° and precision parameter (k) of 15.0 during demagnetisation up to 520°C. The remanence, however, moved away from these northerly directions towards southerly downward directions during thermal demagnetisation along planar trajectories. Specimen remanence typically becomes increasingly spurious with demagnetisation above 600°C. In some samples the remanence is resolved further along these trajectories away from the north-up (normal) remanence towards a south-down (reverse) magnetisation. The reverse magnetisation is best resolved in specimen WS02 (Fig. 18), but in most specimens it was not fully resolved before magnetisations became spurious (possibly due to the conversion of goethite to magnetite during the heating process). The reverse magnetisation is constrained in nine specimens as either linear trajectories towards the origin or as planar trajectories away from the lower stability north-up components and was quantified using the method of McFadden and McElhinny (1988) for the combination of line and plane fits. This high-stability reverse magnetisation is located at 186.5° declination and 47.5° inclination with an α_{95} of 23.5° and k of 11.6 (Fig. 18).

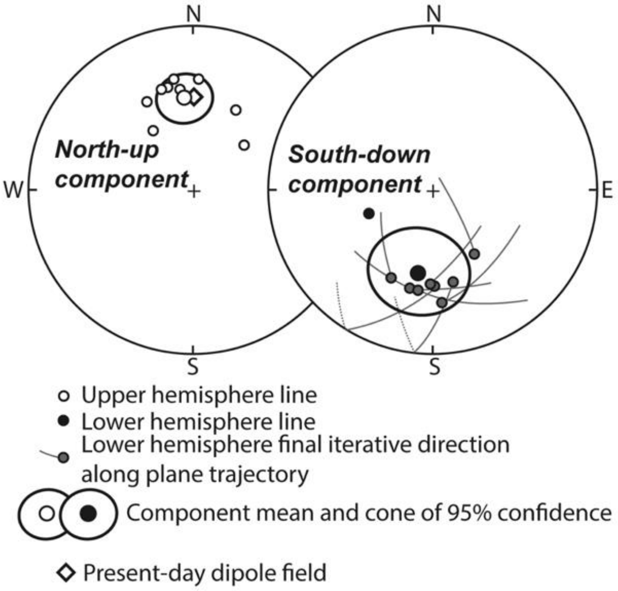

Figure 17. Woodstock Rocks ferricrete terrace: identified magnetic components, their means and 95% confidence cones.

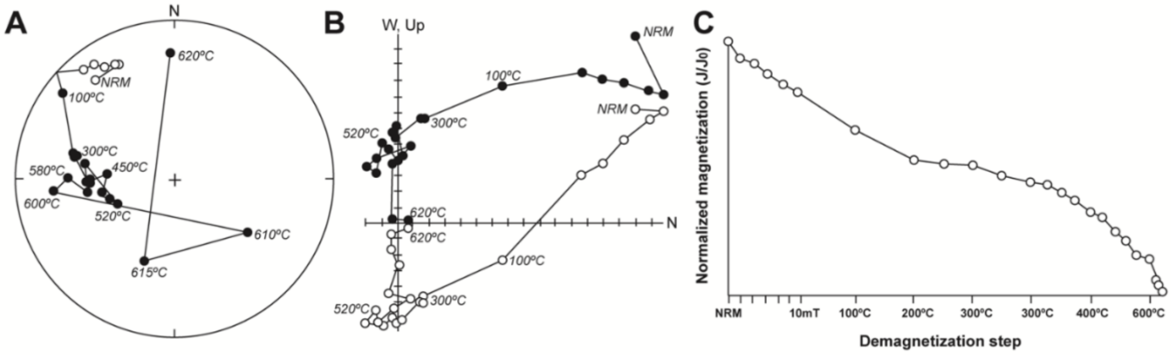

Figure 18. Woodstock Rocks ferricrete terrace: demagnetisation of sample WS02. a) Equal-area projection (open symbols=upper hemisphere magnetisation; closed symbols=lower hemisphere magnetisation); b) orthogonal projection (open symbols=magnetic inclination; closed symbols=magnetic declination; tick marks=10^{-6} A/m); c) normalised magnetisation (J/Jo).

4. Discussion

The southern part of the Woodstock Rocks cliff terrace was used by people in the MSA and LSA, as well as by Iron Age farmers and possibly also by pastoralists using the Mokolo River as a well-watered corridor for their stock. The MSA and LSA lithics on the surface, like points and scrapers, imply that the site was once a domestic locale. In contrast, we can probably rule out the possibility that Iron Age farmers dwelled in the shelter, although there are a few potsherds, grindstones and a 'late white' finger painting. Finger-painted art and ceramics from Happy Rest, Diamant and Eiland facies, demonstrate the presence of Iron Age farmers, but they most likely visited the shelter only occasionally for ritual purposes. While finger-painted farmer art is found throughout the Waterberg (Smith 1999), it is unusual to find only one representational image as is the case at Woodstock Rocks. In other shelters where this type of art occurs there tend to be more paintings and, in such cases, the art is sometimes thought to be used in initiation ceremonies (Smith 1999, 2005). The finger-painted bird motif at Woodstock is also out-of-the-ordinary, regardless of the species intended, though bird images have been recorded at Olieboomspoort, too (van der Ryst 2006).

Ochre powder ground on some of the grindstones may have been used for colouring human skin on some ritual occasions, but it is also an ingredient of the paint that would have been used for the red, brown and yellow rock art at the site. The ochre, grindstones, and the abundant, faded rock art across the cliff face imply that the cliff terrace was used for rituals such as rain-making or initiation ceremonies in the last few thousand years, whereas it may have served other purposes in the deeper past. Rain-making and initiation ceremonies sometimes took place in isolated rock shelters (Schapera 1930; Feddema 1966; Kinahan 2020), for example, from about AD 1000, Eiland facies pots containing offerings were left in rock shelters (Aukema 1989; Huffman 1990, 2007; van der Ryst 1998). Eiland pottery is linked to a period with a great deal of rain-making activity in the Waterberg (Aukema 1989). Part of the initiation ceremonies for northern Sotho and Tswana boys is still conducted in secluded gorges, and here the initiates are taught to hunt, to recognise regiment totems, and to fight the enemy (Jensen Krige 1962; Bruwer 1963). Handprints are relatively common in the rock art of the Waterberg and there are many handprints of various sizes at Woodstock Rocks. Some researchers argue that herders were the authors of the prints (van Rjissen 1994; Smith & Ouzman 2004). The presence of Bambata pottery in the shelter confirms that herders were on the landscape, but we are doubtful that the majority of the handprints in the Waterberg, and at this site in particular, was made by herders. The small yellow handprints seem intimately connected with the Woodstock Rocks fine-line paintings and they were probably made by the same artists. The larger red handprints are for the most part placed some distance from the fine-line art and in some cases these prints are very high on the rock face. Their distance from the fine-line art may be deliberate and perhaps these red handprints are associated with the finger painting in the shelter.

The hunter-gatherer art at Woodstock includes some uncommon imagery. Small carnivores are rare motifs in southern African rock art so the presence of one at Woodstock Rocks is important regardless of whether the depiction is a genet or a white-tailed mongoose. Eland paintings are not unusual in the Waterberg, but they are less common here than, for example, in the Drakensberg (e.g., Vinnicombe 1976) or Cederberg (Hollmann 1993). Other antelope such as hartebeest are better represented in the Waterberg (e.g., Laue 2000). Notably, Woodstock Rocks has at least three eland paintings represented in two different ways. In Figure 6 from Woodstock Rocks Rock Art 2, the eland is painted in white with the body as an outline, whereas yellow and white bichrome eland are portrayed in a Woodstock Rocks Rock Art 1 panel (SOM Fig. 4). Even the seven antelope in the Woodstock Rocks Rock Art 2 panel demonstrate unusual features and they cannot be identified to species. Their long, square muzzles are like hartebeest, but their bodies are unstandardised and not recognisable antelope types. Since the artists were exceptionally competent, the distortion is deliberate and these 'non-real' antelope probably played an important role in the hunter-gatherer belief system.

Although there is hunter-gatherer rock art on the rock walls of the northern part of the cliff, there is scant evidence of MSA and LSA occupation here. Instead, this part of the site, where we excavated (Fig. 2), seems to have been an Acheulean lithic workshop where quartzite was extravagantly knapped and discarded. Large quantities of rock waste are common at Acheulean quarry sites in South Africa, for example in the Karoo (Sampson 2006), and also in other parts of the world, such as India (Petraglia et al. 1999) and northern Israel (Barkai et al. 2016). The frequencies of quartzite cores, including giant ones, together with large frequencies of quartzite flakes, and cortical flakes and chips supports the interpretation of a primary production area at Woodstock. The coarse-grained quartzite used most often at this site was presumably challenging for the knappers. Notwithstanding this handicap, there is some evidence for the knapping of prepared cores at Woodstock, including radial cores and a few that bear some resemblance to the Victoria West cores known from the Karoo, as well as from sites like Montagu Cave (Keller 1973) and Canteen Kopje (Li et al. 2017). Prepared core technology is not unusual in Acheulean assemblages and the Victoria West cores at Canteen Kopje are estimated to be about one million years old (Li et al. 2017), making them broadly contemporary with the Woodstock Rocks assemblage. *Levallois* techniques, more often associated with MSA or Middle Palaeolithic technologies (Gallotti & Peretto 2015; Agam et al. 2022), have a similar volumetric concept to Victoria West cores (Li et al. 2017).

Acheulean knapping techniques included striking large flakes from which LCTs (or scrapers) were later fashioned. On Woodstock's cliff site, several very large flakes lie on the surface, but the excavation yielded few flakes with a maximum dimension larger than 200 mm. In contrast, the river terrace contains some flakes as long as 400 mm and as wide as 300 mm, with a mass as great as 5 kg. It seems likely that one goal at the cliff terrace workshop was to produce large flakes suitable as blanks for shaping LCTs. If this was the case, then the appropriate blanks were probably taken elsewhere to produce LCTs because we excavated only fragments of them, and the large flakes recovered from the excavation trench were not suitable blanks for LCTs. Large blanks from the cliff workshop may have been deliberately transported to the river where they were further shaped and used. This practice was inferred in the Sundays River Valley where large flake blanks (perhaps made from off-site boulder cores) were transported on-site expressly for handaxe production (Lotter & Kuman 2018). However, at Woodstock Rocks some lithics may also have rolled from the steep talus slope of the cliff terrace down to the river terrace. As we have previously suggested, the slope and position of the cliff terrace make this likely. In addition to large flake blanks on the river terrace there are quartzite LCTs, and a variety of tools like giant scrapers, some of which look as though they were failed LCTs repurposed as scrapers. Goren-Inbar and colleagues (2008) showed that in the Acheulean of Israel, the flakes on which massive scrapers were fashioned are by-products of the initial stages of the *chaîne opératoire* aimed to produce bifacial tools. Thus, the production of these massive scrapers depended on the availability of large flakes originating from the knapping of giant cores (Madsen & Goren-Inbar 2004).

The river terrace and the Acheulean assemblage on it became cemented with ferricrete (SOM Figs 10 & 11). We have no way of knowing whether the hardpan formed tens of thousands, hundreds of thousands, or simply hundreds of years after the discard and/or deposition of the implements next to the river, but the human use of the river terrace of necessity predated the formation of the ferricrete. The ferricrete records a northly-up magnetisation, believed to be a viscous remanent overprint that was recorded in the present-geomagnetic field. This recent magnetic overprint, however, partially obscures a south-down (reverse) characteristic remanence that remains stable during thermal demagnetisation up to 600°C. Nine of the ferricrete cores yielded evidence for this high-stability reversed magnetisation, thus we know that the ferricrete terrace was likely cemented during the Matuyama Chron and therefore has to predate 780 ka. Part of the Acheulean sequence in Thomas Quarry, Morocco, also yielded reversed polarity (Gallotti et al. 2021) and can be attributed to the Matuyama Chron, but there are not many African sites fortunate enough to have a chronological framework, even a relative one.

For a while, the lack of dating frameworks led archaeologists to look for technological refinements in Acheulean lithics as a means of seriation. Initially, typological differences between Acheulean assemblages seemed uncertain, particularly because the raw material used plays a role in determining size (Mitchell 2002), as well as the number of flake scars that can be removed from an edge to create a thin cutting edge. Nonetheless, more recent studies suggest that some time-related knapping refinements occurred in South Africa, for example, there appears to be an increase in the effort allocated to flaking later Acheulean handaxes. Greater tip refinement is evident in handaxes from the later Acheulean assemblages in Cave of Hearths compared to those in the Rietputs 15 early Acheulean, dated to about

1.3 Ma (Li et al. 2018). Furthermore, the thinning methods for later Acheulean handaxes resulted in thinner tips than those found on early Acheulean handaxes (Caruana 2020). At sites like Wonderwerk, where there is a dated sequence and where the same rock type is used through time, it also seems possible to detect chronological changes in technology. Here, the earliest Acheulean to arise from the Oldowan, somewhere between 1.5 and 1.1 Ma ago, contains simple bifacial technology that subsequently developed into handaxe production with non-invasive flaking (Chazan 2015).

The Wonderwerk sediments contain several normal and reversed polarity signals, interpreted to have occurred between 0.78±0.18 Ma to 1.85±0.23 Ma (Matmon et al. 2012). Uranium-lead (U-Pb) dating of speleothems buried in Stratum 5 gave an age of 0.548±0.027 Ma, while two samples from Stratum 10 yielded U-Pb ages of 0.839±0.026 and 0.734±0.069 Ma (Pickering 2015). Woodstock Rocks therefore fits chronologically in the middle of the Wonderwerk sequence, a period that is not well-represented in southern African sites. Early dates like those at Wonderwerk have also been found at Sterkfontein, where the Acheulean assemblages appear to have developed from an earlier Oldowan Industry, at about 1.7 Ma ago (Kuman 1994; Kuman & Clarke 2000). Another early Acheulean site, at Rietputs, in Vaal River gravels, generated a range of cosmogenic burial ages between 1.89±0.19 and 1.34±0.22 Ma ago (Gibbon et al. 2009). The final stages of the later Acheulean are represented at sites like Amanzi Springs, in the Eastern Cape, where there are dates between about 534 and 390 ka ago (Caruana et al. 2023). Like Woodstock, Amanzi is interpreted as an Acheulean workshop that was visited repeatedly to access rocks, water and other resources. Although dates for the Acheulean are not abundant anywhere, the chronology is sufficiently well-established to demonstrate that the technology was long lasting, relatively conservative, and that it probably survived in some areas until about 300 ka ago. Surprisingly, an even younger OSL age estimate of 222±31 ka has been obtained for the final Acheulean occupation (layer 21) in Montagu Cave where side-struck flakes from quartzite boulder cores were used to manufacture LCTs (Archer et al. 2023). Not only was the Acheulean long lasting, it was also geographically widespread, occurring, for example, from the southernmost tip of South Africa to Atapuerca, Spain (Lombao et al. 2023), India (Petraglia et al. 1999; Mitchell 2002) and China (Kuman et al. 2016).

Cave or rock shelter sites with Acheulean assemblages are rare in South Africa, perhaps because the hominins stayed away from them until they were able to reproduce fire for themselves, and could then use it for protection against predators like leopard and hyena that tend to make use of rock tunnels and caves. In South Africa, Acheulean cave occupations are recorded only at Olieboomspoort (Mason 1962; van der Ryst 2006), Montagu (Keller 1973; Archer et al. 2023), Cave of Hearths (Mason 1962; McNabb 2009) and Wonderwerk (Volman 1984; Beaumont & Vogel 2006; Chazan 2015). As mentioned at the beginning of the paper, a few LCTs were recovered from the basal layers of the Waterberg site, Olieboomspoort, in both the Mason (1962) and van der Ryst (2006) excavations. Two coarse-grained quartzite cleavers from Mason’s excavation are illustrated by Val and colleagues (2021: fig. 12), who did not recover any Acheulean lithics when their test excavations reached bedrock, suggesting that visits to this site were rare in the ESA. This makes Woodstock Rocks the first substantial Acheulean site in the Waterberg, as well as the first dated ESA site in the area.

Woodstock Rocks was attractive for hominins in the ESA because it has in abundance two desirable resources – water, and rocks suitable for knapping. Hominins in the ESA were tethered to water sources, such as rivers, lakes or pans (e.g., Sampson 1972, 1985, 2006), and their lithics tend to concentrate within an easy distance for obtaining water, but not too close to risk danger from carnivores (Sampson 2006). Woodstock Rocks fits this well-established pattern, as does Wonderboom in the Magaliesberg (Lombard et al. 2021). Although Acheulean knappers are known to have transported rocks considerable distances from their outcrops or deposition areas, there are also workshop sites where knappers would have produced blanks suitable for LCTs that would then have been removed from the workshop area (Goren 1979). This pattern of transport may result in workshop sites that do not have large flake blanks or LCTs. At some Acheulean sites like this, there are more cores than flakes, or at least a higher-than-expected proportion of cores suggesting that the flakes made at the workshop site were transported elsewhere (Goren 1979; Caruana et al. 2019). Smaldeel 3, in the flood basin of the Gariep Dam, Upper Karoo, is a hornfels quarry site studied by Sampson (2006) that yielded no handaxes, cleavers, or even roughouts or preforms from LCTs. His subsequent surveys revealed that biface preforms occurred in less than one per cent of the known quarries. This suggests that the Smaldeel large blanks were transported to activity areas where they were later shaped and used. A similar situation was recorded at Gesher Benot Ya'aqov (GBY), Israel, where layers V-5 and V-6 have a near-absence of handaxes, but side-scrapers, end-scrapers and burins are present in these Acheulean assemblages (Goren-Inbar & Sharon 2016). Handaxes are rare in this part of the GBY sequence, yet several flake types from the biface knapping process were found. These include short, wide flakes that are thick at the proximal end and that resulted from attempts to create a striking platform for removing thinning and shaping flakes. Also included are resharpening flakes and small flakes with edges that retain remains of a bifacial edge, and snapped handaxe tips (Goren-Inbar & Sharon 2016). Although the Woodstock excavation was small and the lithic assemblage is therefore a mere shadow of what must lie on the cliff terrace, the diagnostic elements of Acheulean knapping are present in low frequencies. Woodstock's coarse-grained quartzite makes the recognition of scar types and flake removals difficult, and we were not able to differentiate shaping or thinning flakes, but with further excavations and a larger lithic sample that includes more fine-grained quartzite (a rock type present in low frequencies in our excavation), it may be possible to get a better idea of the *chaîne opératoire* of large cutting tool production on the cliff terrace. At Cave of Hearths, where quartzite whole flakes dominated the collection, as they do at Woodstock Rocks, McNabb (2009) showed that it is not possible to differentiate the products of core working from those of large cutting tool thinning and shaping. Furthermore, he showed that flaked flakes and their spalls smudge the boundaries between blanks, waste products and tools (McNabb 2009: table 7.13). Barkai and colleagues (2016) also found that at quarry and workshop sites in northern Israel, manufacturing debris from the first stages of bifacial preform production are indistinguishable from debitage ensuing from other strategies.

We, like many other researchers, have, thus far, created the impression that the workshop at Woodstock Rocks was solely intended for the production of large flake blanks that would be further knapped into LCTs. However, Gallotti and Peretto (2015) warn that Acheulean technology was not exclusively focused on producing LCTs. *Chaîne opératoire* studies of core and flake assemblages, such as those from Isernia La Pineta, Italy, dated to about 0.6 Ma, demonstrate that small debitage technology is neither opportunistic nor unstructured (Gallotti & Peretto 2015). Instead, at this site, knappers deliberately concentrated on a discoid method of flaking to produce medium-sized flakes intended for small tool manufacture. Thus, we should not automatically assume that all Acheulean workshop sites aimed to produce LCTs alone, or aimed to produce them at all. In some Israeli workshop sites, a curated lithic production *chaîne opératoire* occurs together with simple flake production (Barkai et al. 2016) and perhaps this situation was common. At Penhill Farm, an Acheulean site in the lower Sundays River Valley, Eastern Cape, the most common retouched tools were small ones, especially scrapers (Lotter 2020). These small tools were knapped on site, presumably for site-specific tasks.

Sites, like Woodstock Rocks, retain quantities of cortical flakes, non-cortical flakes unsuitable for tool-making, and much debitage that includes chips, and flakes for the trimming or shaping of tools or for rejuvenating cores. The vast majority of flakes was recovered from layer Brown at the base of the Woodstock sequence. Quartzite formed a far higher percentage of flakes and chips, in layer Brown, than siltstone ones. We are not able to claim with certainty that there were repeated Acheulean exploitations of Woodstock's quartzite resource over a long period. Undoubtedly, though, palimpsests of lithics are represented at the site. It may not be possible to tease out separate palimpsests, yet the excavation has four clear stratigraphic units. We are fairly confident in ascribing one palimpsest, the oldest, to layer Brown where a rockfall sealed some of the lithics and entrapped others. Square F3, closest to the cliff face has the least disturbance, but even square F2, on the terrace's dripline, has few lithics that are obviously contaminants from more recent occupations. Mostly, it is the siltstone component of the assemblage that is likely to have intruded from MSA occupations. Rare chalcedony tools, like thumbnail scrapers, are LSA inclusions. The rock type distribution suggests that, unlike the quartzite *chaîne opératoire*, the siltstone knapping process did not begin on the northern cliff terrace where we excavated; there are only five siltstone cores and four cortical flakes. Nonetheless, there are a great many siltstone chips, suggesting that siltstone artefacts were completed and/or sharpened at the site.

5. Conclusion

Woodstock Rocks is a painted cliff site with a shallow overhang at its southern end, while the northern area is less sheltered, but has the cliff as protection on its eastern aspect. The cliff terrace was used repeatedly by hominins during the Acheulean and the site represents the first Acheulean lithic workshop excavated in the Waterberg. Some favoured quartzite flake blanks may have been carried downhill to the Mokolo River terrace directly below the cliff terrace, and other lithics may have tumbled there from the steep talus slope. The river terrace and its associated Acheulean lithics have been cemented by ferricrete that postdates the hominin activity. The palaeomagnetic study of the ferricrete provides the first, albeit broad, chronology for the ESA in the Waterberg and it shows that the cementation of the Acheulean lithics took place during the reversed polarity of the Matuyama Chron, before 780 ka ago. The more recent *Homo sapiens* use of Woodstock Rocks was during the MSA and LSA. The presence of Bambata pottery in the southern area implies that herders may have been in the area by 2000 years ago. Just a few kilometres from Woodstock, fine-line paintings of fat-tailed sheep were made in Kaingo Sheep Rock Shelter above a stream feeding the Mokolo River (Wadley et al. 2022). Iron Age farmers also used the site from about 1000 years ago, evidenced by ceramics and finger-painted rock art.

Unfortunately we could not date the Woodstock Rocks MSA or LSA occupations, so our original research aim remains unfulfilled. Nonetheless, our preliminary excavations suggest that the site is worth further investigation and excavation, particularly to expand the sample of lithics from the Acheulean workshop.

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Supplementary online material

Wadley et al. Supplementary Online Material File 1

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