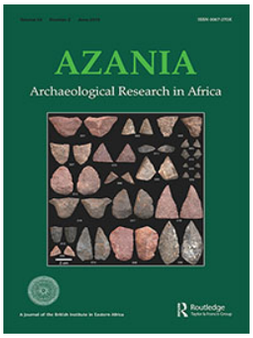

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Grinding-stone implements in the eastern African Pastoral Neolithic

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ABSTRACT
Grinding-stone tools are a poorly utilised source of archaeological information in eastern Africa. Their presence is noted in multiple contexts, including both domestic and funerary, yet the inferences drawn from them are often limited. This short review paper presents existing information on grinding-stone tools (and stone bowls) from Pastoral Neolithic (PN) contexts in eastern Africa. Data on the diverse grinding-stone tool assemblages of the Pastoral Neolithic have been compiled with a focus on details of morphology and spatial, temporal and contextual distribution. Summarising what is known (and, perhaps more importantly, what is not known) about grinding-stones in the Pastoral Neolithic, this paper serves as a reminder that the function of grinding-stone tools was neither singular nor their significance simplistic.

RÉSUMÉ
Les outils de broyage en pierre représentent une source d'informations archéologiques insuffisamment exploitée en Afrique orientale. Leur présence est notée dans de multiples contextes, tant domestiques que funéraires, mais les déductions tirées de ces objets sont souvent limitées. Cet article passe en revue les informations existantes sur les outils de broyage et les bols en pierre provenant de contextes du Néolithique Pastoral (PN, à savoir Pastoral Neolithic, en anglais) en Afrique orientale. Les données sur les divers assemblages sont présentées en mettant l'accent sur les détails de la morphologie des objets et sur leur distribution spatiale, temporelle et contextuelle. Résumant ce que l'on sait (et peut-être plus important encore, ce que l'on ne sait pas) concernant les outils de broyage dans le Néolithique Pastoral, cet article rappelle que la fonction de ces outils n'était ni singulière ni leur signification simpliste.

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Introduction

One of the critical periods in which the function of grinding-stone tools has been debated is that of the East African Pastoral Neolithic (PN, ~3400–1300 BP). The Pastoral Neolithic in eastern Africa is distinguished by Later Stone Age lithic industries, at least two

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archaeological traditions (the Savanna Pastoral Neolithic and the Elmenteitan) and livelihoods oriented towards herding (Bower 1991; Lane 2013). Lower grinding-stones (herein called grinding-slabs) and handstones are also abundant across a diversity of Pastoral Neolithic contexts (often alongside stone bowls) and were initially thought to indicate the development of a fully-fledged 'Neolithic' featuring the cultivation of domestic cereal crops (Leakey and Leakey 1950; Odner 1972; Onyango-Abuje 1977; Robertshaw and Collett 1983; Bower 1991). This interpretation was later challenged in the absence of direct evidence for agriculture, with faunal remains at PN sites demonstrating the widespread utilisation of domestic animals (and in some cases wild fauna) suggestive of a well-developed pastoral, rather than farming, economy (e.g. Robertshaw 1990; Marshall and Hildebrand 2002). The significance of grinding-stone tools in PN contexts therefore remains moot.

This paper summarises the published data on the distribution and morphology of Pastoral Neolithic grinding-stone tools as an empirical contribution to the archaeology of eastern Africa, and provides a short discussion on the interpretive potential of these objects. We note here that many PN grinding-stone tools derive from funerary contexts, raising interesting questions about the symbolic and social aspects of grinding beyond the purely functional. We hope that this review will spark new interest in grinding-stone tools and provide a starting point for future studies that revisit this important aspect of the PN archaeological record.

Reader be warned, the sites discussed here (Figure 1) do not represent an exhaustive catalogue of ground stone tool use during the PN. Some sites, for instance Old Government Farm (M. Leakey 1943: 311; Brown 1966: 69), Jangwani II (Mehlman 1989: 483), the Matete River Site (Mehlman 1989: 484), Nasera Rock (Mehlman 1989: 502), Ilkek-Mound B (Brown 1966), Ol Orien Farm (Brown 1966), Seronera Site SE-3 (Bower 1973), North Horr (Phillipson 1977: 71), Maringishu (Bower *et al.* 1977: 129); Crescent Island Causeway (Bower *et al.* 1977: 134) and Gil Gil (Bower *et al.* 1977: 135), have evidence for stone bowls but, as other grinding-stone implements have not been reported, we do not explore them further in this paper. In other localities, for example Naishi Rockshelter, Maua Farm (Mturi 1986: 53–54), Lemigushira (Mturi 1986: 54), Kitembelien Farm (Mturi 1986: 54), Wasendo Madukani (Mturi 1986: 58), Rigo Cave (Wandibba 1983), Kiama kya Mbiti (Bower *et al.* 1977: 140), the Lemek Valley (Marshall and Robertshaw 1982: 174), Amboseli (Shoemaker 2018: 56) and Nderit Drift, stone bowls and other grinding-stone tools have been collected or otherwise noted, although the provenience and quantities of these finds are tenuous. Also not discussed within this article are ground stone axes. Ground stone axes found in PN contexts may have been used as horn-shapers, as has been documented ethnographically amongst the Pokot and other pastoral groups in eastern Africa (Brown 1990). Alternatively, Robertshaw and Collett (1983:72) have suggested that ground stone axes were once used as agricultural hoes. Ground stone axes may have been manufactured in similar ways to other grinding-stone tools, but it is not obvious that they were used for grinding tasks and they have thus been excluded from this review.

In what follows, we have focused on evidence for grinding-stones from sites where the provenience, quantities and attributes of tools were best documented. The level of detail relating to grinding-stone tools from the sites mentioned here still varies considerably. Presenting this variation underscores the importance of working towards establishing some standard practices for the reporting and analysis of grinding-stone tool assemblages in eastern Africa.

Grinding-stones in the PN

Grinding-slabs have been recovered from a number of Pastoral Neolithic sites across East Africa such as Narosura, the Nakuru Burial Site, Crescent Island (Main), Njoro River Cave, Keringet Cave, Egerton Cave, Prospect Farm, Naivasha Rock Shelter, Eburu Station Lava Tube Cave and Ngamuriak (Table 1). Detailed morphological information on grinding-stones from these sites is often limited, but grinding-slabs tend to be manufactured from basement complex rocks, are sub-rectangular in shape and have flat upper and lower working surfaces (see Figure 2 for examples). Hollowing, likely due to use wear, is exhibited on some stones. Grinding-slab dimensions from the excavation reports of Narosura, Njoro River Cave, Egerton Cave, Ngorongoro Crater and the Nakuru Burial Site are listed in Table 2.

Upper, mobile, handheld grinding-stones (handstones) are also reported from many PN sites (Table 1). While we prefer the more neutral term handstone (Shoemaker *et al.* 2017), as it does not assume tool function, many tools were instead categorised by the authors referenced in Table 1 under the catch-all term 'pestle-rubber'. Presumably those tools referred to simply as 'rubbers' were thought to have been predominantly used in a back and forth motion, with the term 'pestle' reserved for when the tool was employed for crushing and rotary grinding. A great deal of morphological variability is expressed among these handstones, although all have one or more working surfaces characterised by flattened facets with evidence of crushing, polishing, and/or striations (see Figure 3 for examples). Many of the pestle/rubbing stones recovered from PN sites, in common with the lower grinding-stones, are made of hard basement complex rocks. Dimensions of pestle/rubbing stones from the excavation reports of Njoro River Cave, Hyrax Hill, Narosura, Keringet Cave, Egerton Cave and Ilkek-Mound C are listed in Table 3.

Other ground-stone artefacts commonly described as stone bowls, but also termed platters, pudding basins, flat-saucers and flat-bottomed mortars, are found at PN sites in the greater Rift Valley area, frequently in association with grinding-slabs and/or handstones (Table 1). Merrick (1973) gives detailed information on variations in the size and shape of the stone bowls recovered from select PN sites, which we do not repeat here. We include stone bowls tentatively within the category of grinding-stone tools, although as we elaborate below we recognise that the function and significance of this artefact type was likely not singular.

Towards an understanding of tool form and function

Interpreting the presence of grinding-stone tools as a proxy indicator of cultivated cereal crops has particular relevance in Pastoral Neolithic archaeological contexts. A major point of contention revolves around the timing of the introduction of cereal cultivation and its relationship to pastoral livelihoods in Kenya and Tanzania (Marshall and Hildebrand 2002; Lane 2004). The development of herding during the Pastoral Neolithic was initially thought to coincide with a broader shift to cultivation and the use of domesticates (both plant and animal), an assumption made in part because of the associated appearance of new ceramics and various grinding-stone implements (including bowls and 'rubbers'). These items were initially seen as hallmarks of a widespread 'Neolithic' tradition and it

Table 1. Ground-stone tool types found at Pastoral Neolithic sites in eastern Africa (* indicates burial sites).

Site	Stone type	Count	Lithic material	Associated hand-stones	References
Narosura	Stone bowl	≥2	Lava-ash/tuff and biotite gneiss	21 pestle/ rubbing stones made of quartzite, basalt, and tuff	Odner 1972
	Grinding-slab	7	Muscovite schist/quartzite		
Nakuru Burial Site*	Stone bowl	>3	Lava	-	L. Leakey 1931: 200–231
	Grinding-slab	>1	-		
Crescent Island Main	Stone bowl	3	Lava/tuff	2 pestle/rubbing stones	Onyango-Abuje 1977
	Grinding-slab	>1	-		
Njoro River Cave*	Stone bowl	78	Lava/tuff	78 pestle/rubbing stones made of granite, nepheline phonolite, quartzite, rhyolite, diorite, nyyanzian, and microgranite	Leakey and Leakey 1950
	Grinding-slab	77	Eight made from volcanic rock, 69 made from quartzite		
Hyrax Hill*	Stone bowl	12	Tuff	5 pestle/rubbing stones made of basement complex quartz, schistose-quartzite, and garnet gneiss	M. Leakey 1943
Keringet Cave*	Stone bowl	9	Lava	1 quartzite pestle rubber, 1 pestle, and 2 quartz rubbing stones	Brown 1966: 71; Cohen 1970
	Grinding-slab	1	-		
Prolonged Drift	Stone bowl	≥1	-	≥1 pestle	Isaac *et al.* 1972; Nelson 1973; Gifford *et al.* 1980: 64
Egerton Cave*	Stone bowl	6	-	1 pestle-rubbing stone of micaceous material	Faugust and Sutton 1966
	Grinding-slab	4	Hard micaceouus		
Ilkek-Mound C*	Stone bowl	2	Crystal tuff and trachyte	1 pestle-rubbing stone and 1 rubbing stone, both quartzite	Brown 1966
Prospect Farm	Stone bowl	4	Tuff	6 pestle-rubber fragments	Cohen 1970
	Grinding-slab	3	-		
Ngorongoro Crater*	Stone bowl	11	Tuff and vesicular lava	11 quartzite/quartz/grey lava/pink granite pestle-rubbers	Sassoon 1968
Naivasha Rock Shelter*	Grinding-slab	1	-	≥1 handstone	L. Leakey 1942; Nelson 1973: 346
Luxmanda	Stone bowl	2	-	2 ovoid handstones (pestle-rubbers)	Grillo *et al.* 2018
Eburu Station Lava Tube Cave*	Stone bowl	18 fragments	Lava	≥1 conical lava handstone	
	Grinding-slab	≥3	Lava		
Ngamuriak	Grinding-slab	3		3 rubbers	Robertshaw 1990: 98

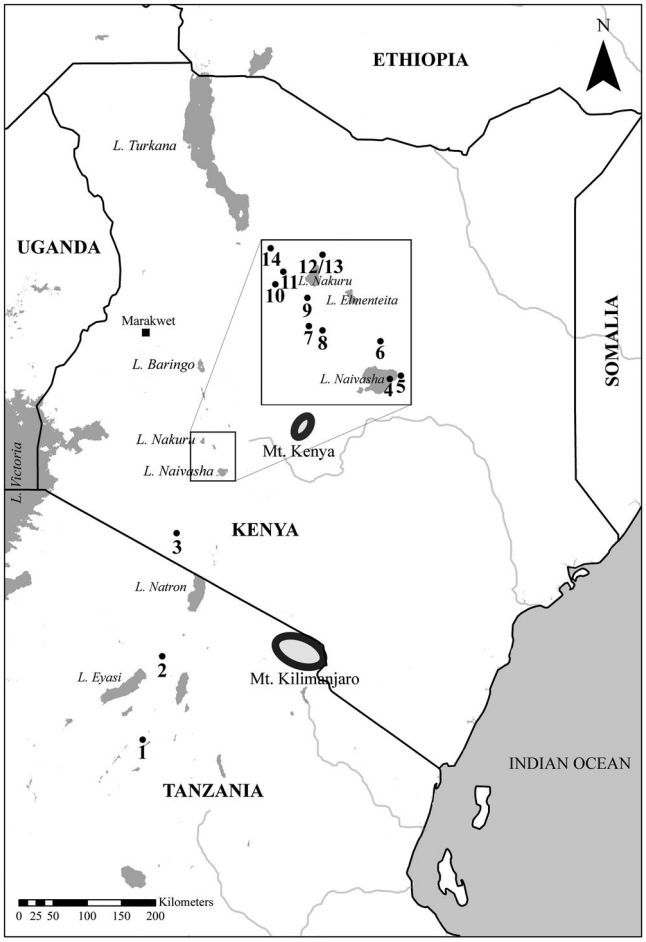

Figure 1. Map of East Africa showing the Pastoral Neolithic sites mentioned in the text: 1 Luxmanda; 2 Ngorongoro Crater; 3 Narosura; 4 Crescent Island; 5 Naivasha Rock Shelter; 6 Ilkek-Mound C; 7 Eburu Station Lava Tube Cave; 8 Prospect Farm; 9 Prolonged Drift; 10 Njoro River Cave; 11 Egerton Cave; 12/13 Hyrax Hill and the Nakuru Burial Site; 14 Keringet Cave; 15 Ngamuriak.

was assumed that pastoralism likely coincided with cereal-based agriculture. This narrative has since been substantially revised in the light of evidence suggesting a long pastoral phase prior to the widespread emergence of farming communities (Marshall and Hildebrand 2002), although the lack of systematic archaeobotanical sampling from excavated contexts must surely caution against assuming that all forms of cultivation of plant species were universally absent during the PN (Crowther *et al.* 2018: 489; Shoemaker 2018: 151–152). There remains, for example, the possibility that some Pastoral Neolithic communities engaged in human-plant interactions involving management typical of low-level food production (*sensu* Smith 2001). While avoiding the simplistic notion that grinding-stones are but hallmarks of 'Neolithisation', their widespread appearance in East African PN contexts could suggest links between an intensification of grinding activities and transitions in food production strategies that have yet to be fully understood.

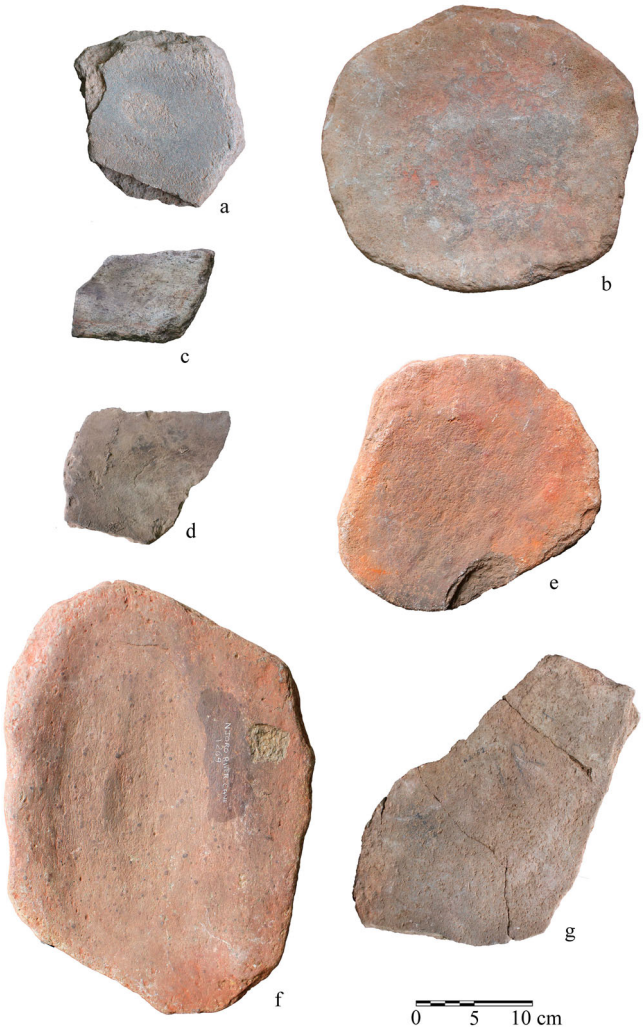

Figure 2. Examples of grinding-slabs from Pastoral Neolithic sites mentioned in the text: a) fragmented slab exhibiting hollowing, Naivasha Railway Rockshelter; b) slab with pronounced ochre staining, Keringet Cave; c) fragmented slab, Hyrax Hill; d) fragmented slab, Eburu Station Lava Tube Cave; e) slab with pronounced ochre staining, Njoro River Cave; f) slab with pronounced ochre staining exhibiting hollowing, Njoro River Cave; g) fragmented slab, Njoro River Cave.

For example, Robertshaw and Collett (1983: 72) contend that grinding-slabs recovered from Pastoral Neolithic sites are larger than those from Late Stone Age hunter-gatherer assemblages. This disparity in tool size is of potential interest as variations in the surface area of grinding-stone tools through time have been associated with changes in the intensity of grinding activity (e.g. Dubreuil 2004; Nixon-Darcus and D'Andrea 2017). In the compilation of this review, one pattern noticed is that the articulation surfaces of the lower grinding-stone tools listed in Table 2 are smaller than those measured on contemporary tools used by agropastoralists in the Marakwet region of northwestern Kenya for the processing of maize, sorghum and millet (Shoemaker *et al.* 2017). Similarly,

Table 2. Published dimensions of grinding-stones recovered from Pastoral Neolithic sites in East Africa.

Site	Length (cm)	Width (cm)	Mean thickness (cm)	Mean thickness at edge (cm)	Description	Reference
Narosura	17.5	17.5	1.9	-	Grinding-slab	Odner 1972
	24.0	14.0	8.1	-	Hollowed fragment of grinding-slab	
Njoro River Cave	43.0	23.0	1.0	3.0	Grinding-slab	Leakey and Leakey 1950
	31.0	27.0	5.0	-	Grinding-slab	
	26.0	21.0	2.5	-	Grinding-slab	
	43.0	33.0	2.5	-	Grinding-slab	
	30.0	20.0	3.0	4.0	Ggrinding-slab	
Egerton Cave	20.0	12.0	3.2	-	Grinding-slab	Faugust and Sutton 1966
Ngorongoro Crater	57.0	26.0		4.5	Grinding-slab	Sassoon 1968
	35.0	25.0	2.3	-	Grinding-slab fragment, size is estimated	
Nakuru Burial Site	35.4	25.5	6.5	-	Grinding-slab	L. Leakey 1931: 200–231

handstones used to process cereals in Marakwet generally tend to be longer, wider, and thinner than the PN pestles/rubbers listed in Table 3. While recognising that the twenty-first-century inhabitants of Marakwet (with diets largely based on domesticated cereals) and Pastoral Neolithic communities are not in any way directly comparable, the smaller size of the tools encountered at PN sites allows us to begin to hypothesise about how differences in the intensity of grinding activity, or even differing levels of reliance on cereal crops, may be reflected in East African tool-kits. We acknowledge that morphological analysis is rendered challenging due to the fragmentary nature of many grinding-stone artefacts, yet tool counts, quantitative measurements and illustrations are too often lacking, even where tools were recovered intact. Even basic improvements in the reporting and description of grinding-stones from archaeological contexts (i.e. tool counts, dimensions, lithic raw materials) will facilitate the identification of patterns in grinding traditions through time and space.

With regards to the actual function of PN grinding-stones, we emphasise that these tools should be understood as multipurpose. While the most frequently cited use for grinding-stone tools in Africa is plant processing, both the ethnographic and archaeological records lend support for there having been numerous processing tasks performed with various grinding-stone tools for different functional and social applications throughout the PN (e.g. David 1998; Gosselain and Livingstone Smith 2005; Lyons 2014; Nic Eoin 2015). Grillo (2012), for instance, describes how the pastoralist Samburu of Kenya use grinding-slabs and handstones to process seeds (e.g. *Balanites orbicularis, Myrsine africana*) and roots (e.g. *Albizia anthelmintica*) for medicinal purposes, as well as tobacco leaves (*Nicotiana tabacum*), red ochre and, during pottery production, hardened lumps of clay. Pastoral Neolithic grinding technology was likewise probably used for the processing of both organic and inorganic materials. What looks to be silica sheen on grinding-slabs and handstones from sites such as Njoro River and Keringet Cave suggests that some implements were used to process silica-rich grasses. Light brownish-yellow staining on grinding-slabs and handstones has also been noted at Njoro River Cave (Leakey and Leakey 1950: 21), Keringet Cave (Brown 1966: 71), Narosura (Odner 1972: 56), Crescent Island (Onyango-Abuje 1977: 154),

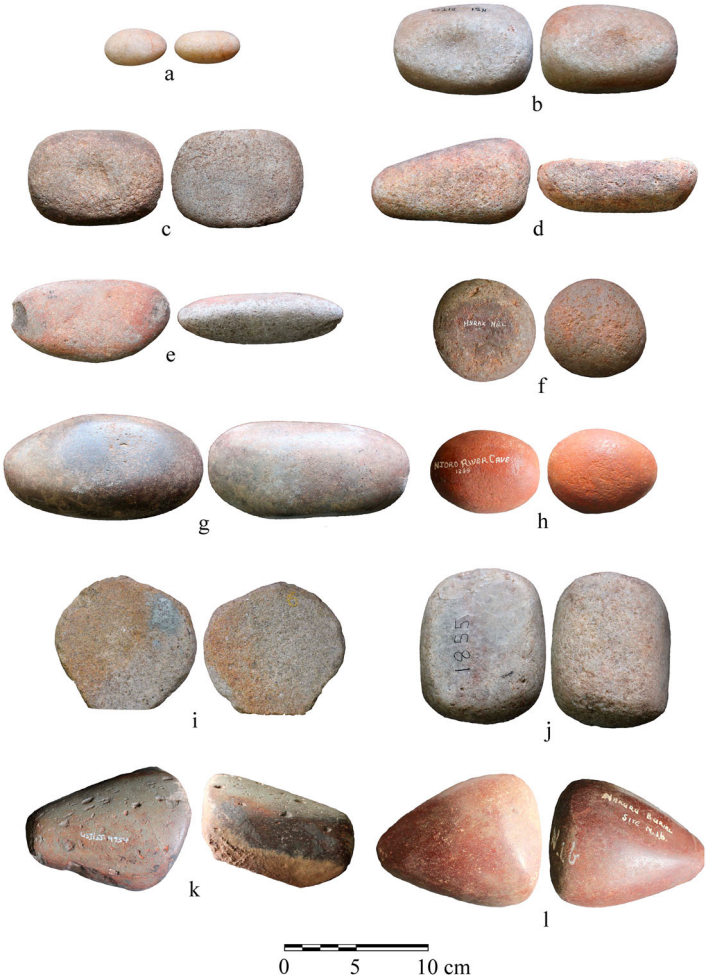

Figure 3. Examples of handstones from Pastoral Neolithic sites mentioned in the text: a–b) quartz handstones, Narosura; c–d) handstone, Narosura; e) handstone, Naivasha Railway Rockshelter; f) handstone, Hyrax Hill; g) handstone, Keringet Cave; h) handstone with pronounced ochre staining, Njoro River Cave; i) handstone, Ilkek-Mound C; j) handstone, Naivasha Burial Mound; k) handstone, Eburu Station Lava Tube Cave; l) handstone, the Nakuru Burial Site.

Ngorongoro Crater (Sassoon 1968: 19) and Eburu Station Lava Tube Cave, indicating that these tools were likely used to process ochre.

Suggested functions for stone bowls include their use as mortars. The co-occurrence of stone bowls and pestle/rubbing stones, in the absence of grinding-slabs, at sites such as Hyrax Hill, Prolonged Drift, Ilkek-Mound C and Ngorongoro Crater raises the possibility that these particular handstones were used with these stone bowls for grinding. Ochre staining found on both pestle/rubbing stones and stone bowls at Njoro River Cave lends further credence to the hypothesis that these artefact types are linked, although it is not always clear if this staining resulted from these items being used to grind ochre, or if it occurred due to their deposition in a layer of pigment (Leakey and Leakey 1950: 2). At this stage it is not possible to conclude that stone

Table 3. Published dimensions of pestle/rubbing stones recovered from Pastoral Neolithic sites in East Africa.

Site	Description	Length (cm)	Maximum diameter (cm)	Minimum diameter (cm)	References
Njoro River Cave	Pestle-rubbing stone	9.25	5.55	5.1	Leakey and Leakey 1950
		9.75	4.95	4.7	
		7.6	4.2	4.1	
		7.65	3.85	3.8	
		9.7	5.7	5.6	
		9.4	5.8	5.35	
		7.2	4.8	4.6	
		7.7	6.15	6	
		6.3	4.8	4.2	
		7.3	5.3	5	
		9.75	4.7	3.2	
		8.55	6.1	5.2	
		9.4	5.6	4.6	
		8.7	4.1	3.6	
		9	6.1	4.1	
		5.6	5	4.05	
		9.5	8.1	5.1	
		10.3	6.4	4.75	
		13.4	6.6	5.75	
		9.7	5.3	4	
		10.2	5.1	4.6	
		10.5	5.6	5.05	
		8.8	6.7	4.3	
		7.25	5.2	4.8	
		6.2	4.3	3.7	
Hyrax Hill	Pestle-rubber	10.2	7.6	6.6	M. Leakey 1945
	Pestle-rubber	10.4	5.3	6.5	
	Pestle-rubber	9.4	6.1	5.6	
	Pestle	9.7	6.6	5.6	
Narosura	Pestle-rubber	5.5-9.5 (range of maximum lengths of 21 stones)	-	-	Odner 1972
Keringet Cave	Pestle-rubber	10.0	7.0	4.0	Cohen 1970
Egerton Cave	Pestle-rubber	9.7	6.9	4.3	Faugust and Sutton 1966
Ilkek-Mound C	Rubbing-stone	8.6	8.5	1.2	Brown 1966
	Pestle-rubber	7.0	5.2	5.2	

bowls found at PN sites were unequivocally grinding-stone tools. The presence of charring on the interior surfaces of some bowls at Njoro River Cave (Leakey and Leakey 1950: 15), Hyrax Hill (M. Leakey 1943: 327), Ilkek Mound-C (Brown 1966: 64), Ol Orien Farm (Brown 1966: 69) and Rigo Cave (Wandibba 1983: 84) implies that while they may have been used to process charred material organic matter may have also been burned inside them. Stone bowls have thus been interpreted as incense burners, brasiers/lamps and even as indirectly heated cooking vessels (M. Leakey 1943; Leakey and Leakey 1950; Cole 1963: 287–288; Clark 1981). These interpretations must be evaluated cautiously as in some instances evidence for charring on vessels may be associated with comparatively indiscriminate burning episodes, especially where bowls are found with cremated human remains, as is common at Elmenteitan sites (Ambrose 2001; Sawchuk *et al.* 2018: 196). Although stone bowls have received comparatively more attention than PN grinding-slabs and handstones (e.g. Merrick 1973), with the naming of Pastoral Neolithic industries having even once been the 'Stone Bowl Culture', there are still many lines of inquiry to follow with regard to the exact function and significance of these implements.

It seems clear that more careful recording of grinding-stone tool morphology and variation, and — where appropriate — focused microwear and trace/chemical analyses will be informative, especially in determining basic functional uses. Phytolith and starch grain analyses of PN grinding-stone tool assemblages featuring highly visible silica sheen could potentially shed light on the oft-overlooked utilisation of non-domesticated plant resources (e.g. Mercader 2009; Radomski and Neumann 2011; Ball *et al.* 2016). Recent progress in the elemental fingerprinting of ochre deposits in the Kenya Rift Valley (Zipkin *et al.* 2017) also opens up the possibility of determining the origins of the ochre found on PN grinding-stones and thus of exploring patterns in wider landscape resource use. The potential remains to investigate whether different PN communities used distinct ochre sources, or manufactured their grinding-stone tools from specific lithic materials, as has previously been observed in relation to obsidian found on Elmenteitan and SPN sites in the Central Rift Valley (Merrick and Brown 1984). Just as there is scope to further techniques for recording grinding-stone tool function and form, there is also room to explore how grinding-stone tools may illuminate on the social behaviours and symbolic referents of Pastoral Neolithic people.

Funerary associations, performance and knowledge and communities of practice

We have argued elsewhere (Shoemaker *et al.* 2017) that grinding-stones are often viewed as mundane, quotidian objects, and are thus prone to being discussed from a more narrow, functionalistic perspective. Grinding-stone tools may also, however, be approached as items of material culture steeped in larger symbolic and social significance. While by no means suggesting a direct ethnographic analogy, our research on contemporary grinding practices in Marakwet, Kenya has found that grinding of a variety of materials is heavily associated with a range of everyday social performances facilitating the transfer of knowledge concerning food, gender, family and community. The role of grinding-stones in education and the recreation of notions of identity and tradition are especially evident in the continued production of small grinding-stone tools for children in Marakwet. As was observed in relation to differences in grinding traditions between Marakwet and Pokot

people, grinding-stone tools in archaeological contexts may contain information on 'communities of practice' (Lave and Wenger 1991; Wenger 1998) or the transmission of knowledge, skills, and socially proscribed ideas regarding proper ways of doing and making.

A future potential area of inquiry will be to determine if there are notable distinctions in grinding-stone form, function and quantity across assemblages that have been labeled SPN, Elmenteitan or under the broader categorisation of 'hunter-gatherer', as a means of understanding how people in the Pastoral Neolithic established community membership. Grillo *et al.* (2018: 113) have, for example, suggested that stone bowls may be more frequently found at SPN habitation sites in comparison to Elmenteitan. In contrast, Merrick (1973) was unable to detect significant patterning distinguishing SPN and Elmenteitan stone bowl assemblages using quantitative measurements and a qualitative typology.

To explore potential differences and similarities a step further, in Table 4 we have indicated which of the sites discussed in this paper are affiliated with SPN and Elmenteitan cultural groupings, in addition to providing radiocarbon dates from excavated deposits. While it is not possible to discern any significant patterning yet, Figures 4 and 5 offer a basic visualisation of the variation in grinding-stone tool sizes among sites affiliated with SPN and Elmenteitan industries. Admittedly, the sample size is small. The possibility remains however, that we are unable to detect a pattern because no such definitive SPN and Elmenteitan grinding traditions exist. Although SPN and Elmenteitan archaeological sites tend to exhibit differences in ceramic wares, flaked stone-tool lithic technology and settlement patterns, they do not obviously represent ethnolinguistically discrete or biologically isolated groups (Ambrose 2001; Marshall *et al.* 2011; Sawchuk 2017). Further complicating interpretations is the existence of a great deal of diversity within so-called SPN lithic and ceramic assemblages, with distinct traditions being lumped together under the SPN banner (Ambrose 2001). As was also noted during observations of grinding-stone tool use in Marakwet, many other factors need to be considered when evaluating changes in grinding-stone tool assemblages across space and time, including the degree of mobility of tool users, changes in the materials being processed using grinding-stones, and the ease with which quality lithic resources suitable for manufacturing grinding-stone tools can be accessed. Currently, the paucity of recorded grinding-stone dimensions and systematic programs of microwear and trace residue analysis from Pastoral Neolithic contexts (and from those that pre- and post-date the PN) renders it difficult to distinguish communities of grinding practice among culturally, geographically, economically or temporally disparate groups, but there is scope to improve this.

We must also emphasise here that while grinding-stone tools are often central to food preparation and thus everyday life, they cannot be entirely evaluated as quotidian objects. In Marakwet, for example, we observed the continued use of grinding-stone implements for key life stage rituals, especially those involving the production of castor oil, ochre, and beer. Grinding-stone tools in Marakwet thus remain salient today, even when the more general functionality of these stones (such as for daily culinary tasks) has been greatly diminished by the introduction of diesel grinding mills. The ceremonial and symbolic significance of Pastoral Neolithic grinding stone tools are likewise most conspicuous in their connection to funerary traditions.

Stone bowls, flat-handstones and pestles and flat grinding-slabs are found together in funerary rather than domestic contexts at the Nakuru Burial Site, Njoro River Cave, Hyrax Hill, Keringet Cave, Egerton Cave, Ilkek-Mound C, Ngorongoro Crater,

Table 4. Archaeological cultural affiliations and dates for sites discussed in the text. Radiocarbon dates were calibrated using the SHCal 13 curve (Hogg *et al.* 2013) in OxCal v.4.3 (Bronk-Ramsey 1995).

Site	Archaeological 'cultural' affiliations	Material dated	Laboratory number	Uncalibrated date BP	Calibrated date (two-sigma)	References
Narosura	SPN	Charcoal	N-700	2360 ± 110	769–144 cal. BC	Odner 1972
			N-703	2640 ± 115	980–407 cal. BC	
			N-701	2660 ± 115	1006–411 cal. BC	
			N-702	2760 ± 115	1217–542 cal. BC	
Nakuru Burial Site	SPN	-				
Crescent Island Main	SPN	Bone gelatine	GX-4587	2795 ± 110	1262–592 cal. BC	Onyango-Abuge 1997
		Bone gelatine	GX-4586	2535 ± 110	841–379 cal. BC	
		Bone gelatine	GX-4589	2660 ± 110	997–416 cal. BC	
		Bone apatite	GX-4585	2660 ± 110	997–416 cal. BC	
		Bone apatite	GX-4588	2405 ± 110	786–207 cal. BC	
Njoro River Cave	Elmenteitan	Charcoal	Y-91	2920 ± 80	1280–841 cal. BC	Cole 1963: 286
		Charcoal	Ya-220	2900 ± 75	1257–838 cal. BC	Merrick and Monaghan 1984
		Charcoal	Ya-221	3090 ± 65	1490–1088 cal. BC	
		Charcoal	Ya-222	3165 ± 100	1628–1110 cal. BC	
Hyrax Hill	SPN	Bone apatite	GX-4582A	1295 ± 105	Cal. AD 601–995	Onyango-Abuje, reported in Ambrose 1984
		Bone gelatine	GX-4582G	1995 ± 125	352 cal. BC – cal. AD 357	
Keringet Cave	Elmenteitan	Charcoal	N-654	2430 ± 110	795–211 cal. BC	Cohen 1970
		Charcoal	N-655	2050 ± 110	356 cal. BC – cal. AD 230	
Prolonged Drift	SPN	Ivory collagen	GX-5735G	2530 ± 160	975–206 cal. BC	Gifford *et al.* 1980
		Ivory apatite	GX-5375A	2315 ± 150	781 cal. BC – cal. AD 15	
Egerton Cave*	Elmenteitan	-				
Ilkek-Mound C	SPN?	-				
Prospect Farm	SPN	Charcoal	UCLA1234	2690 ± 80	1007–540 cal. BC	Cohen 1970
		Charcoal	N-651	2910 ± 110	1380–813 cal. BC	
Ngorongoro Crater	SPN?	Bone	GX-1243	2260 ± 180	778 cal. BC – cal. AD 114	Sassoon 1968
Naivasha Rock Shelter	SPN	Bone collagen	GX-4583G	2000 ± 135	356 cal. BC – cal. AD 358	Onyango-Abuje reported in Ambrose 1984
Luxmanda	SPN	Tooth apatite	ISGS-A2819	2145 ± 25	203–58 cal. BC	Grillo *et al.* 2018
		Tooth apatite	ISGS-A2818	2395 ± 25	537–373 cal. BC	
		Tooth apatite	ISGS-A2817	2515 ± 25	770–430 cal. BC	

(*Continued*)

Table 4. Continued.

Site	Archaeological 'cultural' affiliations	Material dated	Laboratory number	Uncalibrated date BP	Calibrated date (two-sigma)	References
		Tooth dentine collagen	ISGS-A2940	2580 ± 25	800–543 cal. BC	
		Pottery	ISGS-A2367	2855 ± 20	1051–896 cal. BC	
		Charcoal	ISGS-A3798	2880 ± 20	1107–913 cal. BC	
		Charcoal	ISGS-A3797	2900 ± 20	1116–928 cal. BC	
		Charcoal	ISGS-A3796	2905 ± 20	1120–929 cal. BC	
		Charcoal	ISGS-A3799	2905 ± 20	1120–929 cal. BC	
		Bone collagen	ISGS-A3806	2925 ± 20	1192–941 cal. BC	
		Pottery	ISGS-A2820	2960 ± 25	1215–1011 cal. BC	
Eburu Station Lava Tube Cave	Elmenteitan	Charcoal	ISGS-2323	2090 ± 70	351 cal. BC – cal. AD 114	Ambrose 1997
		Charcoal	ISGS-2322	3570 ± 70	2113–1665 cal. BC	
Ngamuriak	Elmenteitan	Charcoal	GX-8533	2135 ± 140	539 cal. BC – cal. AD 210	Robertshaw 1990: 303
		Charcoal	GX-8534	1940 ± 140	355 cal. BC – cal. AD 389	

Naivasha Rock Shelter and Eburu Station Lava Tube Cave (Table 1). A rather substantial number of grinding-stone implements found in PN contexts have, in fact, come from funerary deposits and while this may in part reflect a bias in archaeological research the significance of the intentional internment of such tools at burial sites should not be overlooked.

As has been noted before (e.g. Gifford-Gonzalez 1998; Ambrose 2001: 102) grinding-stone tools may be one way to explore gendered mortuary treatments among diverse communities of PN people through time. For example, at Njoro River Cave, an Elmenteitan burial site, of the 78 individuals estimated to have been interred here (male and female), all were buried with a stone bowl, a grinding-slab and a pestle-rubbing stone (Leakey and Leakey 1950). Robertshaw and Collett (1983: 72) have even detected a tendency for grinding-slabs with ochre staining to be found with male rather than female burials at Njoro River Cave. In contrast to the gender distribution at Njoro River Cave, at the SPN site of Hyrax Hill Mary Leakey (1943) reported that of the nine stone bowls and three pestle/rubbing stones that were placed with human remains all were associated with female interments. Thus, we may also benefit from thinking about culturally structured depositional practices during the PN (Gifford-Gonzalez 2014), in addition to using quantitative descriptions of stone tools to differentiate communities of grinding practice.

That said, the burial practices of specialised herders during the PN display a high degree of heterogeneity and there is a rather widespread acknowledgement that the socio-cultural significance and diversity of funerary contexts in eastern Africa have often been poorly conceptualised by archaeologists (e.g. Davies 2013: 235; Sawchuk *et al.* 2018). Further

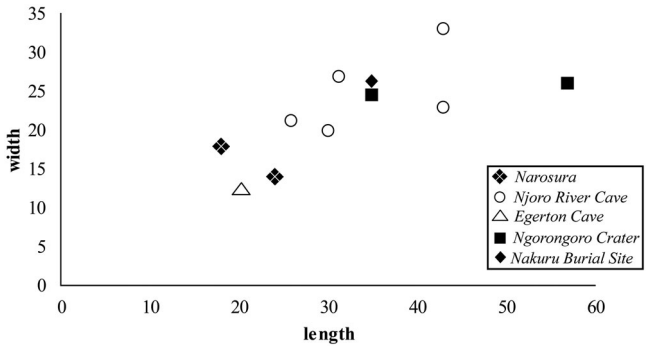

Figure 4. Scatterplot of Pastoral Neolithic grinding-slab length and width measurements (cm). Filled in symbols represent SPN sites, outlined symbols Elmenteitan sites.

complicating understandings of the chronological resolution and cultural associations of grinding-stones are that small-scale funerary monuments such as stone burial cairns (e.g. Hyrax Hill and Ilkek Mound-C) seem in some cases to have been locales for repetitive human activities with evidence for re-use and secondary burial, in some cases over considerable periods of time (e.g. Lane *et al.* 2007; Hildebrand *et al.* 2011; Straight *et al.* 2015). This evidence does, however, suggest that these monuments may have held important mnemonic and performative associations and that the deposition of grinding-stone tools within burial features had significance beyond the realm of the purely functional grave good.

There are many other intriguing leads in the PN archaeological record, including envisioning how the performative act of grinding featured in ceremonial occasions. The act of grinding ochre is clearly associated with funerary proceedings at Njoro River, where a thick layer of ochre was found to cover the floor of the cave (Leakey and Leakey 1950: 2). At the Nakuru Burial Site the appearance of an incomplete stone bowl along with a tool thought to have been used in its manufacture is particularly suggestive (L. Leakey 1931: 200–231). As much as the finished article, the act of creating the stone bowl, of grinding the object into being, may have been of significance in the funerary traditions of the people who deposited it. Additionally, many stone bowls at Njoro River Cave appear to have been made of a softer, more friable lithic material than those found at

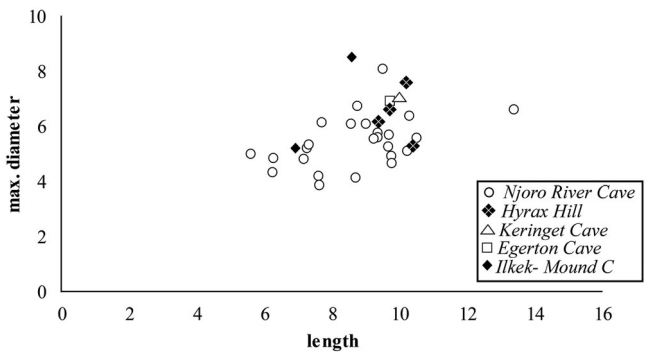

Figure 5. Scatterplot of Pastoral Neolithic handstone length and width measurements (cm). Filled in symbols represent SPN sites, outlined symbols Elmenteitan sites.

other PN sites (Leakey and Leakey 1950: 11), and as they are not suited for any sort of heavy pounding or grinding activity, their presence may again attest to how the funerary traditions of some Pastoral Neolithic people incorporated grinding-stone tool making performances. Similarly the unmaking of stone bowls may have been of importance to judge from the fact that at Ilkek-Mound C stone bowls are believed to have been deliberately broken before being left at the site (Brown 1966: 63). Fragmented grinding-slabs and handstones are quite common occurrences at the sites discussed in this paper, although there is no mention in the literature of whether or not their breakage was intentional. The possibilities for further exploring PN funerary and social practice through grinding and related implements thus seem considerable.

Conclusion

Pastoral Neolithic grinding-stone assemblages, while not a straightforward indication of agricultural practices, are indeed still worthy of further inquiry. More careful recording of tool forms is certainly necessary to advance comparative analysis. Sampling PN grinding-stones for phytolith and other trace residue/use-wear analyses should also be encouraged in order to build up an understanding of the functions of these implements. We should equally like to draw attention to grinding as a performative act, one with both ritual and symbolic importance. Grinding-stone tools, particularly when found in funerary contexts, suggest that grinding was not just a means to an end in the Pastoral Neolithic. We thus hope that this brief review will inspire further studies of this technology and the practices with which it was associated.

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