DANIELA HOLST

EQUIPPING THE LANDSCAPE: THE USE OF STATIONARY STONES IN THE EARLY MESOLITHIC

Abstract

Among the "Ground Stone Tools" assemblages of the Mesolithic sites of Duvensee, Friesack 4 and Rothenklempenow 17, a small group of large stones stand out. Designated as "*stationary stones*", these display use-wear traces on their wide working surfaces, which speak in favour of a use as anvils. In comparison to a recently used nut cracking stone from a mangetti nut groove in Namibia, use wear on the archaeological samples only formed weakly to moderately. Remarkably, most of the "*stationary stones*" analysed have been detected at Duvensee, *Wohnplatz 8*, a late Preboreal camp for hazelnut processing. Following ethnographic examples, an installation of these stones in the landscape is assumed. This supports the notion of Mesolithic land use strategies as being effective and provident.

Keywords

Land use, ground stone tools, early Holocene, archaeology of recent hunter-gatherers

INTRODUCTION

When we consider stone artefacts, we usually think about sharp-edged implements of siliceous raw materials that were more or less carefully shaped for hand-held or hafted use. This is especially true during the Mesolithic, where stone artefacts are typically tiny, ephemeral, follow distinctive typologies and technologies, and are mobile, leaving certain relics of the artefacts use life at different places in the landscape. This allows archaeologists to trace movements; for example, by raw material procurement strategies, retooling of removed weapons, or the distribution of technological traditions.

The type of ground stones tools presented here stands in stark contrast to this common notion of stone artefacts as carefully shaped, fast-moving tools. *Stationary stones* are neither mobile, nor modified, but bulky blocks, supposed to have been positioned in the landscape for long-term, passive *in situ* usage. Therefore, they contain important hints on land use strategies. Still, these inconspicuous stones have rarely been intensively studied, at least for the Mesolithic. A total of 13 stationary stones at the sites Duvensee, Friesack 4 and Rothenklempenow 17 have been macroscopically investigated. To gain an idea of the ways these stones have been used, and their land use contexts, an ethnographic example is described beforehand.

Drawing attention to immobile stone implements instead of small fast-moving tools might also change our views on Mesolithic land use strategies: whereas these people have historically been regarded as following an exclusively highly mobile lifeway, newer investigations provide more evidence that supports an interpretation of reduced mobility in restricted and well-maintained territories. Here, Mesolithic groups made their living on the large-scale exploitation of stationary resources like nuts or fish (cf. Holst, 2010; Boethius, 2017).

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GROUND STONE TOOLS

"Ground Stone Tools" (GST) or macro-lithic tools are stones that are modified using motions like abrasion, percussion, polishing, grinding, pounding or pecking (Adams et al., 2009: 43; Dubreuil et al., 2015: 106). For these tasks more granular stone types – which are tougher and less brittle – are usually chosen. As this definition covers a wide range of stones, it includes carefully polished bifacial axes, as well as unmodified hammer stones, grinding plates or mortars. Beyond their function as tools these stones have also been used as heat conductors (e.g., cooking stones, roasting plates) and as settlement equipment, including construction stones, wall supports, seats or weights. Macrolithic tools were often used *ad hoc*, in a versatile and multi-functional way over the long-term. Considering this, a single stone could accumulate information regarding all different aspects of life. GST are among the oldest tools humans used and produced and are therefore important for understanding the evolution of our species. These earliest stone inventories also include large and heavy stones, probably used as anvils (Arroyo and de la Torre, 2020, with references therein). A well-known example from early prehistory are the pitted stones from Gesher Benot Ya'aqov, which were found in different forms and sizes, including large blocks and flat anvils (Goren-Inbar et al., 2002, 2015), and presumably used for nut cracking. In the late Pleistocene/early Holocene GST inventories tend to become larger and more varied (Dubreuil et al., 2015; Spivak and Nadel, 2016). This is probably related to the intensified processing of local resources – especially plants – into storable food supplies (cf. Wright, 1994; Dubreuil and Nadel, 2015).

Furthermore, in the Mesolithic the first polished and drilled tools, like mace-heads or axes, were produced. However, in general Mesolithic GST tend to be unhandsome, unmodified, and with infrequent traces of macroscopic use-wear, making their functions difficult to decode. A long and versatile life of use might additionally complicate their understanding: GST may have been used over long periods of time, with ethnographic records documenting the use of some GST over generations (Dubreuil et al., 2015: 112, with further references therein).

To gain more insight in Mesolithic land use traditions and subsistence strategies, GST from the sites of Duvensee, Friesack 4 and Rothenklempenow 17 (all Northern Germany) are investigated within the project "Functional analyses of Mesolithic ground stone tools", funded by the Deutsche Forschungsgemeinschaft (DFG) (project number 415158854). Within these assemblages a group of large, heavy and compact stones with larger working surfaces stands out (**Fig. 1**). Because of their weight (> 1 kg) and based on ethnographic analogy, we suggest an interpretation of permanent installation in the landscape at the places of use. This is why they have been named "stationary stones". Such large compact stones or boulders are occasionally recorded for Mesolithic settlements and burials. In the context of burials they have been placed as grave stones, construction elements of tombs, and grave goods (examples in: Grünberg, 2000: 98 ff.); some seem to weigh down the deceased like in grave A129 in Nivå (DK) (Lass Jensen, 2016) or grave HB:10 in Vedbæk (DK) (Brinch Petersen, 2016). The few stationary stones mentioned in publications for settlement contexts have been interpreted tentatively after their find contexts beneath fire places, huts or bark mats, often associated with flint waste, as anvils, seats, or construction elements of fire places. They have been detected in Barmose (DK) (Johansson, 1990: 15), Holmegaards Mose (DK) (Becker, 1945: 63), Sværdborg I (DK)

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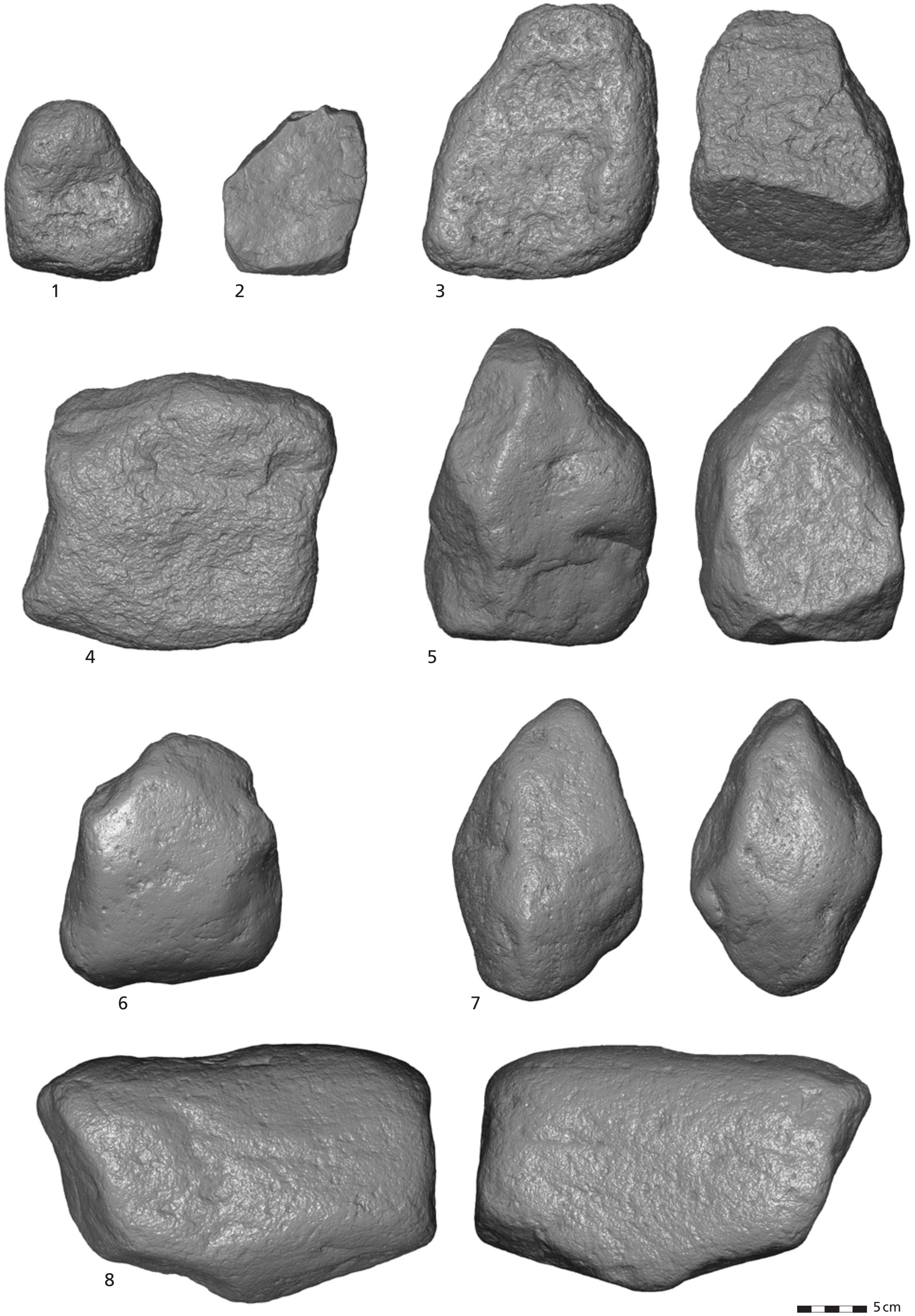
Fig. 1 Selection of stationary anvils from Duvensee (**1-5**), Friesack (**6**) and Rothenklempenow (**7-8**). – **1** ID SH1978-35.**8**; **2** ID MfV1925. 119:012; **3** ID SH1978-35.**9**; upper and lower surface; **4** ID SH2017-27.**47**; **5** ID SH1978-35.**10**; upper and lower surface; **6** Friesack (ID **F72**); **7** Rothenklempenow (ID 99/77, **36**); upper and lower surface; **8** Rothenklempenow (ID 99/77, **46**); for IDs cf. **Tabs. 1-3**. Images after 3D scans compiled in GOM 2019.


1
2
3
4
5
6
7
8
5 cm

(Henriksen et al., 1976: 34), Rottenburg-Siebenlinden (DE) (Kind, 2003: 73-74) or Star Carr (Clark, 1954: 97). Until now Mesolithic "stationary stones" have not been investigated in-depth.

THE USE OF STATIONARY STONES BY HUNTER-GATHERERS: AN EXAMPLE FROM NAMIBIA

The use of heavy stone blocks is still practiced in some parts of the world. Most common are examples of anvils used for cracking marula (*Sclerocarya birrea*) (Boshier, 1965; Marlowe, 2010) and mangetti nuts (*Schinziophyton rautanenii*; also called Mongongo) (Widlok, 1999) in Africa or Quandong (*Santalum acuminatum* R. Br.) in Australia (Pardoe et al., 2019). These nuts provide a rich staple food; their flesh and kernels are consumed either raw, roasted, or fermented as alcohol, and are also exchanged. Large rocks were used as seats (and anvils) and determine site selection in Hadza groups (Marlowe, 2010: 79).
There seem to be some common traits in the provision of these stones and their use: stones were picked up for future use, when the opportunity arose and suitable stones were at hand. Particularly large and heavy stones were often left behind for future use at locations for plant processing, where they were commonly used for many years (e.g., Yellen, 1976; Widlok, 1999; Marlowe, 2010: 79). So stones were not moved away once they reached the place of use, but instead "installed" in the landscape. This is true for hammer stones as well as anvils. The long-term placement of stones in the landscape meant that people did not have to search for new suitable tools every time they are going to process fruits, but instead choose to furnish their harvesting spots. The stones were usually not exclusively used for nut cracking and plant processing, but are typically multi-functional tools, especially in regions where such rocks are scarce (Widlok, 2017; Pardoe, 2019). However, investigations on stone use among Australian Aborigines also provide an example of the exclusive use of specialised anvil stones for cracking quandong nuts (Pardoe et al., 2019).
While the economy of mangetti or marula use is sufficiently described (Yellen, 1976; Widlok, 1999; Marlowe, 2010), nut cracking stones themselves have rarely been further documented (but see Pardoe et al., 2019). Thomas Widlok (University Cologne) kindly allowed investigation of two stones he brought from a mangetti grove in Northeast Namibia (Mangetti West, Farm 6) (Widlok, 2016) and provided me with information about their use context: stones are a rare and valuable commodity in Mangetti. For this reason, their use was long-term and multi-functional. When the opportunity arises, stones are brought from a river bed at about 20 km distance to the nut grove in anticipation of a future use for nut cracking there. They are habitually deposited along the paths within the groves for future use as a common good. As a result, with time the number of stones within the groves increases, as they are rarely taken away or exhausted. Stones of different use-lives and unused stones lie mixed together. The nut-cracking stones are not prepared or modified before use, simply selected for appropriate qualities and "improved" by use. The two stones taken from Mangetti West, Farm 6 consist of a larger compact stone block used as an anvil and a complementary smaller stone used as a hand hammer. The focus of this paper is on the larger compact stone used as an anvil.
The larger stone block consists of a medium grained granite and has an irregular prismatic form (**Fig. 2**). With a volume of 1,738 cm^3 and a weight of nearly 4.5 kg, this block is comparatively large, as most nut-cracking stones in Mangetti tend to be smaller (according to Widlok, 2017: Fig. 4.5, sized like a man's fist). However, for cracking of marula nuts anvils with a weight of up to nearly 23 kg have been recorded (Boshier, 1965).

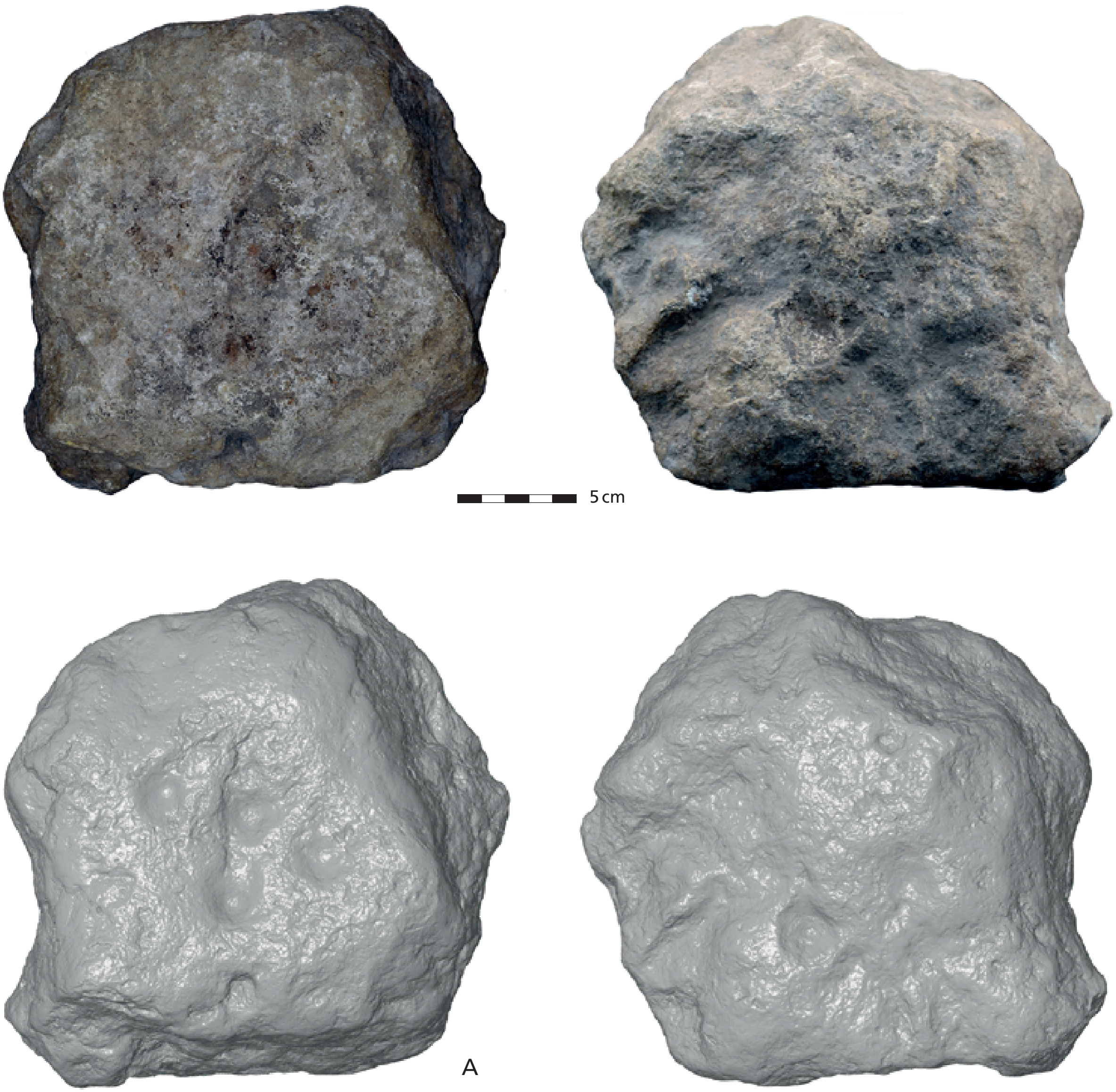


Fig. 2 Recent nut cracking stone from Mangetti West (Namibia), photo and 3D-scan. Clearly visible are the four pits on the upper side (**A**) and two beneath some unregular depressions on the bottom side (**B**), the abraded areas (whitish). Dark and reddish spots are residues, deposited in and around the pits.

Accordingly, the stone surface seems to be quite heavily worn. It has two horizontally opposed working surfaces, each covering a surface of more than 200 cm^2. These surfaces are characterized by several circular pits, each around 1.5 cm in diameter, with a depth of 0.5 cm. Interestingly, the pits have not been formed by intentional modification but developed over time by the use of natural depressions in the initial morphology of the stone (personal communication Thomas Widlok, December 2020). This is also evident on the bottom side of the stone: it was obviously less intensively used and accordingly shows just two circular pits and a few vaguely developed natural depressions towards the margins of the uneven surface (Fig. 2).

At the presumed top side of the mangetti stone, four of these depressions are grouped in the centre of the working surface. The inner faces of these pits feel mostly even and smooth with smoothed border areas,

as if steadily abraded. While the natural surface of the stone is uneven, the area around the pits is extensively levelled by abrasion. These parts appear whitish and slightly rough. Within these areas and scattered beneath the pits are single percussion marks with an elongated triangular outline. Furthermore, there are two fields of parallel striations beside the pit group. The nuts were obviously cracked open by a pounding action, a combination of hitting and dragging. Of course, the stone could also have been used for alternative purposes that may have caused the fields of striations.
Elevations and the edges of the stone are partly worn and glossy like a polish, caused by the repeated handling of nuts, which are hand-held while cracked open. The partial polishing of surfaces of nut cracking stones in the mangetti groves by repeated handling and touching over a long time was already observed by Thomas Widlok during his field work (2017: 108), and was also noticed on nut cracking stones elsewhere (Boshier, 1965; Pardoe et al., 2019).
The most obvious use wear on the nut cracking anvil described here are the pits. Similar pits related to nut cracking have also been recorded on stones from Australia. These pits start as percussion marks, which develop into shallow indentations and then deepen into a steep-sided hole with a depth of up to 2 cm and a diameter of 2-3 cm (Pardoe et al., 2019). In contrast to this are observations during nut cracking experiments (e. g., Roda Gilabert et al., 2012) and descriptions of stones used for cracking of marula nuts, where the anvil surfaces became smoother and more even during use, due to the impact from the hammer stone (Boshier, 1965: 131-132), but without the development of pits.

FIND CONTEXTS OF THE STATIONARY STONES: THE SITES DUVENSEE, ROTHENKLEMPENOW AND FRIESACK

As the use of stationary stones can be regarded as part of a landscape that people modified to suit their needs, the settlement contexts of the stones are important for their understanding. All sites involved are distinguished by excellent organic preservation, which provides a sufficient background on varied subsistence activities. These sites were specifically selected for investigation due to their different functions and occupation times, in order to improve our understanding of diverse find contexts for stationary stones.

Duvensee

At the former Duvensee (Schleswig-Holstein, Germany), islets at the Western lake shore were repeatedly and seasonally used as short-term special task camps from the late Preboreal to the early Atlantic (Holst, 2014; Groß et al., 2018). These camps mainly served for the processing of large amounts of hazelnuts, as well as other subsistence and crafting activities (e. g., retooling of arrows). Enormous amounts of hazelnuts, stones (including heavy GST), sand, and wood for the roasting facilities have been brought to the sites (Holst, 2014). The transport of these items could have been provided by boats, as indicated by the find of a wooden paddle at the *Wohnplatz 2* site.
In total, 9 heavy stationary stones were detected in the find material of the sites ("*Wohnplätze*") 5, 8 and 13 (Tab. 1).
The majority of the GST derive from site *Wohnplatz 8* (LA 18), a late Preboreal site (Fig. 3). Directly on the lakeshore, enormous amounts of hazelnuts were processed in roasting hearths of sand or bark mats (Bokel-

Site	inventory number (ID)	preser-vation [%]	weight [g]	length [mm]	width [mm]	thickness [mm]	volume [cm³]	density [g/cm³]	raw material	distance to settlement structures
Duvensee 5	MfV1925.119:012	100	1,109	128	100	88	435	2.55	sandstone	unknown
Duvensee 8	SH1978-35.**6**	~50	1,650	125	103	95	642	2.57	granite	2 m to central hearth
Duvensee 8	SH1978-35.**7**	~70	2,422	185	119	86	953	2.54	granite	1.5 m to central hearth
Duvensee 8	SH1978-35.**8**	100	1,800	132	115	83	696	2.59	granite	2.5 m to central hearth
Duvensee 8	SH1978-35.**9**	100	2,143	160	126	84	831	2.58	granite	6 m to central hearth
Duvensee 8	SH1978-35.**10**	100	4,263	195	131	116	1,644	2.59	granite	1 m to central hearth
Duvensee 13	SH2017-27.**4**	85	1,681	135	117	80	653	2.57	granite	11 m to central hearth, 14 m to bark mat
Duvensee 13	SH2017-27.**9**	~50	1,479	134	94	90	595	2.49	granite	4 m to central hearth, 3.5 m to bark mat
Duvensee 13	SH2017-27.**47**	100	4,767	180	165	104	1,884	2.53	granite	directly at centre of pine bark mat; 4 m from central hearth
Friesack 4		100	3,137	172	152	94	1,201	2.61	granite/gneiss	
Rothenklempenow 17	99/77, **1603**	50	2,062	164	147	73	848	2.43	granite	~70 m to settlement/burial A, 20 m to settlement B
Rothenklempenow 17	99/77, **599**	100	2,723	220	124	95	1,047	2.60	quartzite	~70 m to settlement/burial A, 20 m to settlement B
Rothenklempenow 17	99/77, **603**	100	7,600	240	151	106	2,634	2.88	porphyry	~70 m to settlement/burial A, 20 m to settlement B

Tab. 1 Origin, morphology and raw materials of stationary anvils under investigation.

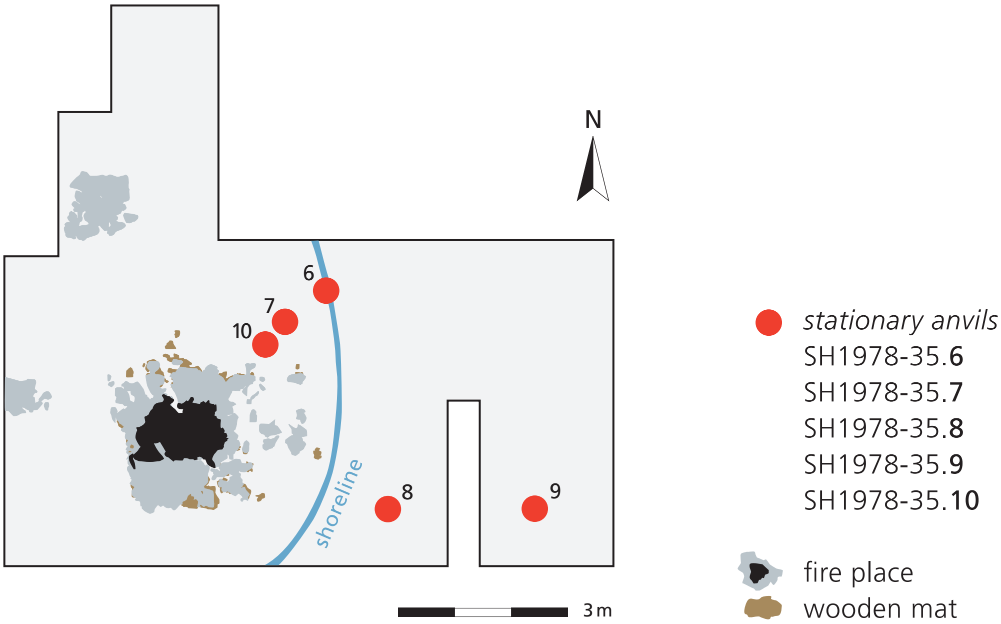


Fig. 3 Duvensee, *Wohnplatz* 8 (LA 18). Excavation area with roasting hearths and position of stationary anvils (cf. **Tab. 1**).

mann et al., 1981; Holst, 2010, 2014). During nut roasting stone artefacts were produced or repaired, with a particular focus on arrow heads (Holst, 2008, 2014). Microliths and microburins were found almost exclusively in the central hearth area. Larger stones and primary production waste, in contrast, have mostly been found beyond the shoreline, imbedded in *gyttja* layers. They had either been tossed into the low water or this area of the lake was used as a workshop for primary flint preparation during seasonal dry periods (Holst, 2014). The stationary stones seem to be an exception, however. With one exception, they derive from the settlement's peat layers, close to the central roasting hearth (< 2.5 m distance, cf. **Tab. 1**), regardless of their size and weight.

The site *Wohnplatz 13* (LA 19) comprises the remains of at least two distinct settlement events. In the central excavation area, a hearth was discovered in close proximity to a possible pine bark mat (**Fig. 4**). It was located directly adjacent to the lakeshore, and associated with a few hazelnut shells and thousands of silex artefacts (Bokelmann et al., 1985). To the east of this a further pine bark mat (190 cm × 70 cm) with a hearth on top was excavated (Bokelmann, 1989). Radiocarbon (^{14}C) dating of the bark assign it to a later settlement, dating to the end of the Boreal/early Atlantic. No lithics or other find materials have been associated with this settlement structure.

In the northern parts of *Wohnplatz 13* a small birch bark mat and a possible hearth have been recovered, associated with a few silex artefacts and hazelnut shells (Bokelmann, 1986).

Three stationary stones have been detected at *Wohnplatz 13*. One stone (ID[1] SH2017-27.**47**) was placed in direct contact with the eastern, younger pine bark mat (**Fig. 3**). The bark mat was partly destroyed in the centre next to the hearth, possibly the result of a former deposit (Bokelmann, 1989: 17). The GST shows

1 ID refers to individual inventory numbers given in **Tabs. 1-3.**

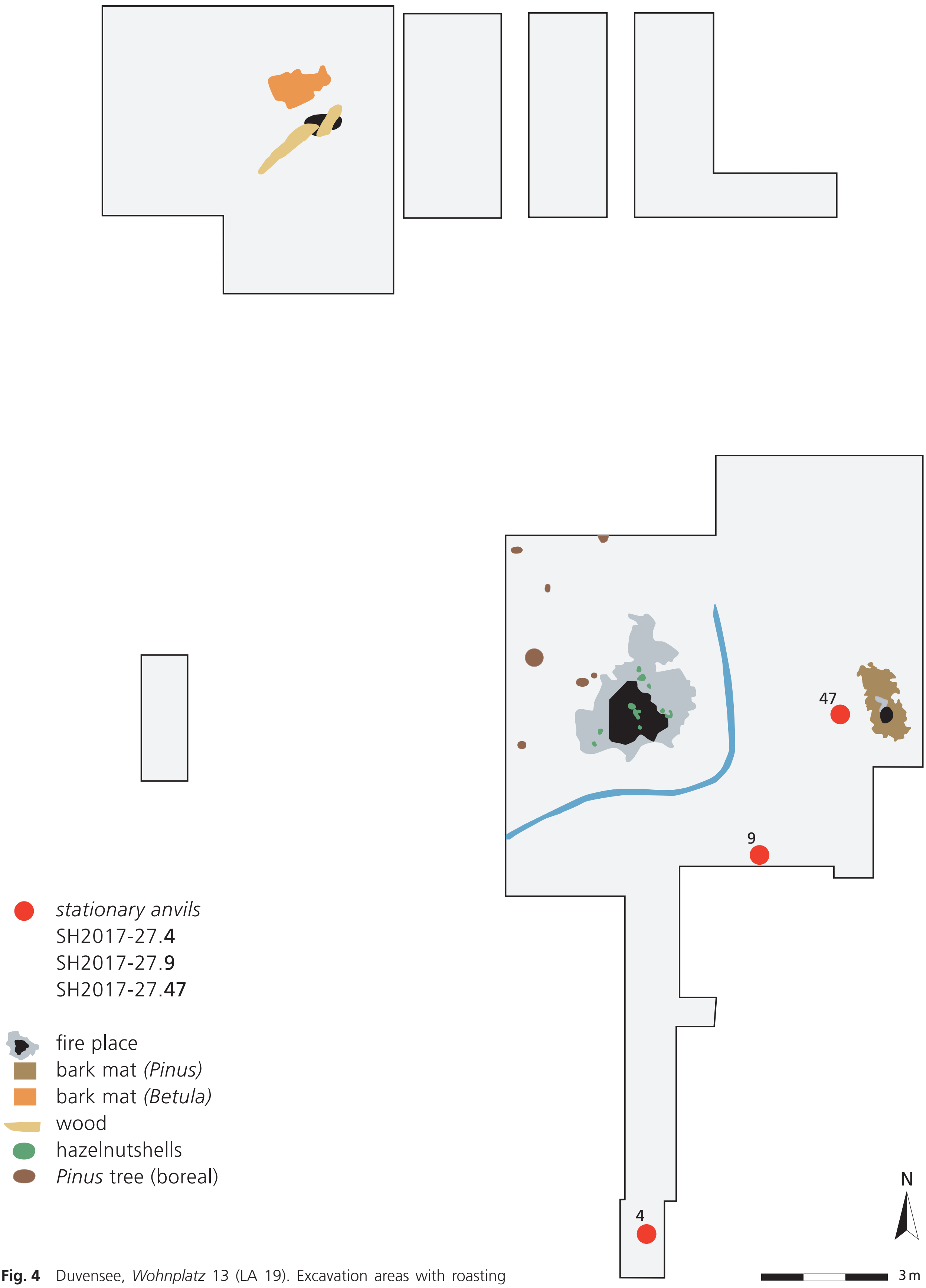


Fig. 4 Duvensee, *Wohnplatz* 13 (LA 19). Excavation areas with roasting hearths, bark mats and position of stationary anvils (cf. **Tab. 1**). – (Modified from Bokelmann, 1995: Fig. 1).

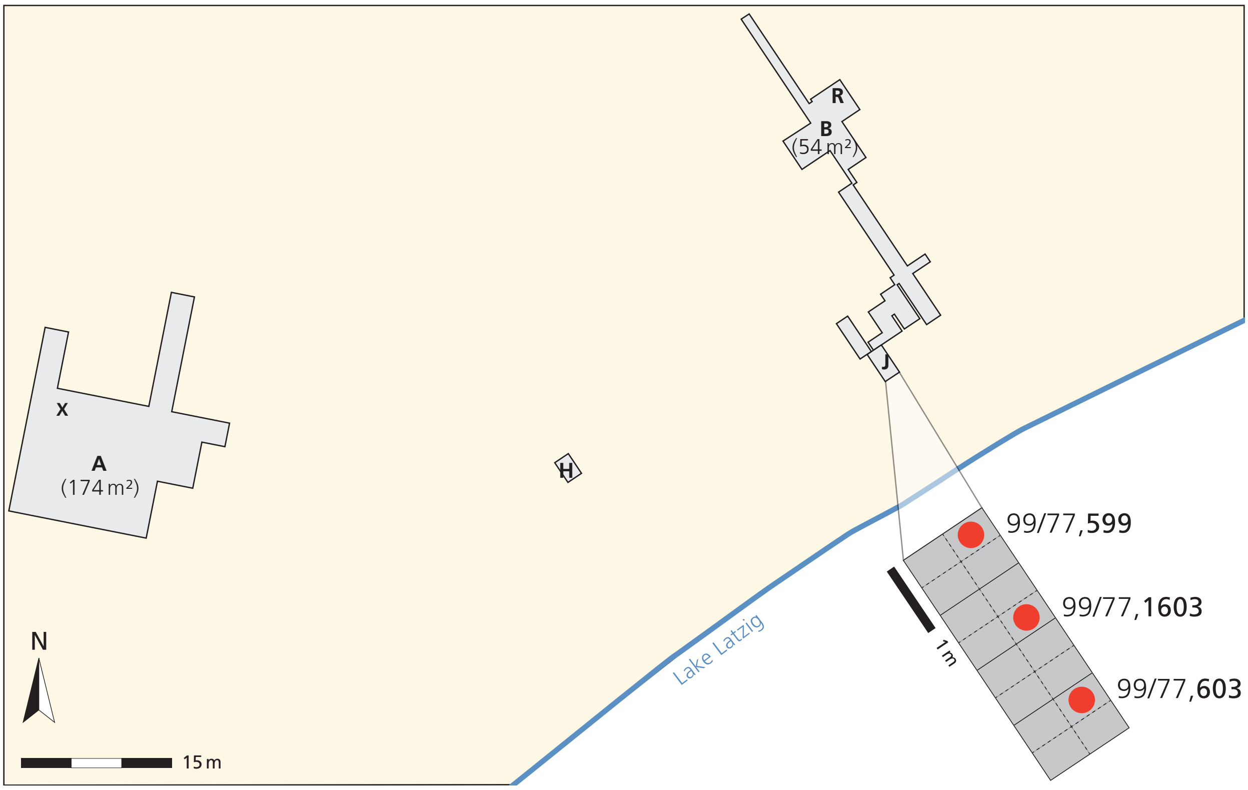


Fig. 5 Rothenklempenow 17. Excavation areas (A, B, H, J, R). Younger Mesolithic settlements have been detected in areas A and B, a burial in area A (marked by x). Dark grey: magnification of area J with excavation grid and position of stationary anvils (cf. **Tab. 1**; excavation plan modified from Elisabeth Noack).

heat damage, which may suggest that the large GST was originally placed in the damaged mat area next to the hearth.

The other two large GST have no close spatial relation to the hearths or bark mats (**Tab. 1**), and it remains unclear how these stones relate spatially to the settlement activities.

Duvensee, *Wohnplatz 5* was excavated in 1925. It differs from the before mentioned sites as five birch and pine bark mats of several settlement events were stacked vertically, separated by layers of hazelnut shells ("*Nussmull*") with peat (Schwantes et al., 1925; Bokelmann, 1971; Jenke, 2011). Several hearths of sand, loam, and charcoal were placed on the bark mats. Concentrations of micro-debitage and percussive stones mark areas of tool production on the bark mats (Jenke, 2011). GST have not been individually documented, but as the excavation area (~30 m^2) was confined to the uncovering of the bark mats, they are spatially directly associated with the mats and hearths.

Rothenklempenow

The Mesolithic site Rothenklempenow 17 (Mecklenburg-West Pomerania) is situated on the North-western lakeshore of the Latzigsee. Several areas have been excavated, covering 242 m^2 in total (**Fig. 5**). The lake shore was repeatedly visited from the mid-Preboreal to the Subboreal (early Neolithic), with the most

intensive visiting period occurring in the mid-Boreal (Schacht and Bogen, 2001). Two settlements (A and B), designated by evident settlement structures like pits or hearths, have been excavated at the shore terrace. They date to a younger Mesolithic period (Schacht and Bogen, 2001). Furthermore, the burial of a woman in a sitting position, stratigraphically assigned to the mid-6th millennium BC (Bach and Bruchhaus, 1995: 28), was discovered at the north-western edge of area A (Schacht, 1993).
Even though the rich find material has yet to be studied in detail, hunting of large ungulates and fishing are regarded as the most important activities at Rothenklempenow (Schacht and Bogen, 2001), based on the quantity of animal bones and remains of fishing gear recovered at the site.
Three stationary anvil stones were detected in trench J (4 m^2) in the accretion zone of Latzigsee, at some distance from the settlement structures A and B (**Tab. 1**). No obvious settlement remains have been detected here, despite numerous well-preserved lithic and organic finds. This part of the settlement was interpreted as an area for accessing the lake and as a toss zone (Schacht and Bogen, 2001). The stationary stones may have been tossed here or used *in situ* during regression phases of the lake. One anvil stone (ID 99/77, **603**) was directly associated with a dated sample from the Preboreal. The other two have been detected in Boreal layers (ID 99/77, **1603** from layer 5b: pollen zone Vc; ID 99/77, **599** from layer 7: pollen zone Va).

Friesack 4

The Mesolithic settlement of Friesack is located on a sandy hill on an island of about 6,000-9,000 m^2, situated at a lakeshore within the Elbe-Oder ice-margin valley (Gramsch, 2001). The settlement itself was destroyed; excavations correspond to the former lakeshore area, where settlement material has been tossed, in some cases possibly deposited, but mostly rearranged by human-induced erosion. The complex stratigraphy of sand, humic sand, and *gyttja* layers corresponds to more than 100 episodic occupations that were grouped into chronologically sequential Complexes I to IV (Mesolithic) and V (Neolithic) (Gramsch, 2001, 2016). They date from the Preboreal to the mid-Atlantic (Gramsch, 2016: Tab. 1), documenting a Mesolithic settlement history of more than 3,600 years. Considering the quantity and diversity of find material and activities documented, Friesack 4 served as a residential site that was occupied for longer times (weeks or months), although not permanently (Gramsch, 2016: 22). According to zooarchaeological investigations of the early Mesolithic inventories, the site was visited in spring and summer (Schmölcke, 2016). Remains of boats and paddles attest the use of waterways for logistics and travelling to the site.
There is just one heavy stationary stone among more than 250 GST. It was detected in trench Z (Quadrant F6), in layer 8b, dating to the Preboreal (cf. Jahns et al., 2016: Tab. 1).

METHODS OF MACROSCOPIC INVESTIGATIONS

Within the case study the GST inventories are analysed macroscopically and microscopically, with focus on the selection criteria for the stones, ways of use, the materials processed, and the relation to fire. Macroscopic analyses included the recording of the morphologies and metrics, raw material, surface qualities, preservation conditions, and possible modifications. The surfaces have been examined by the naked eye and have been screened at low magnification (0.63×/0.116 objective with 10× oculars) by stereo-microscope (*Zeiss SteREO Discovery V8*), using a ringlight and LED swan-neck as light sources, optical zoom 1x-8x.

Furthermore, all stationary stones have been 3D-scanned using an AICON smart SCAN-HE R8 with the M-450 objective (field of view 355 × 265 × 220 mm, point-to-point distance 108 µm). The 3D models have been edited with the GOM Inspect 2019 (Hotfix 8) software package (**Fig. 1**); volumes and surface areas (**Tab. 1**) were computed from the 3D models in GOM. Lab analyses were conducted at the TraCEr Laboratory for Traceology and Controlled Experiments in the MONREPOS Archaeological Research Centre and Museum for Human Behavioural Evolution in Neuwied (DE). Ongoing lab analyses include high-resolution microscopy of surface alterations and sampling for possible residues.

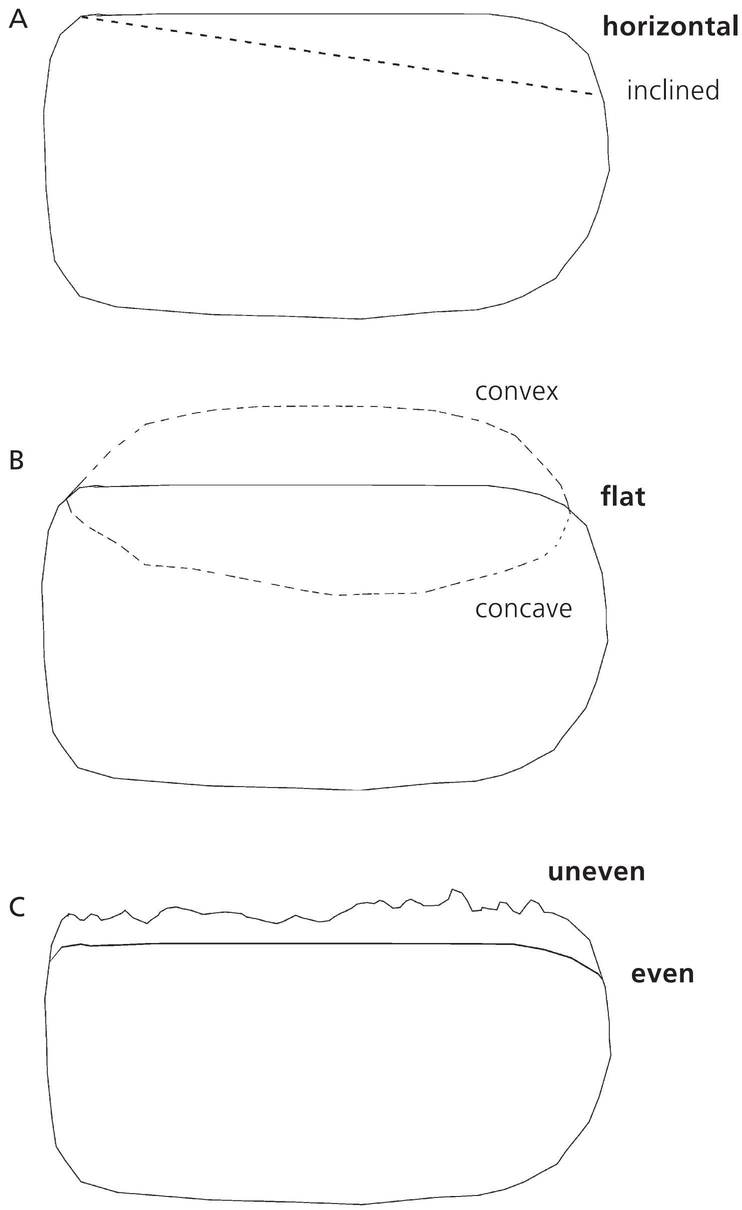


Fig. 6 Schematic representation of working surface forms on stationary anvils: **A** inclination (horizontal or inclined); **B** curvature (flat, concave or convex); **C** topographic relief (even or uneven). Micro-topography (rough or smooth) as fourth criterion is not presentable.

Site	inventory number (ID)	working surfaces [n]	surface preservation	surface area(s) [cm²]	surface orientation	surface curvature (upper/ lower face)	surface relief	surface roughness
Duvensee 5	MfV1925.119:012	1	good	89	slightly inclined	flat	slightly uneven	rough
Duvensee 8	SH1978-35.**6**	1	good	>98 (fragmented)	fragmented	fragmented	fragmented & used	smooth(ed)
Duvensee 8	SH1978-35.**7**	1	badly weathered	138	horizontal	flat	even (weathered or used)	rough
Duvensee 8	SH1978-35.**8**	1	ok	123	horizontal	irregular concave/ level	~even/~even	rough/rough
Duvensee 8	SH1978-35.**9**	1	good	195	slightly inclined/ slightly inclined	slightly concave/ level	slightly uneven/ uneven	rough
Duvensee 8	SH1978-35.**10**	2	good	225/164	slightly inclined/horizontal	sinuous/flat	uneven/even	rough/rough
Duvensee 13	SH2017-27.**4**	2	heat fractured	not measured	horizontal	flat	slightly uneven (weathered or used)	smooth
Duvensee 13	SH2017-27.**9**	1	badly weath-ered & heat damaged	(fragmented)	horizontal/horizontal	flat/flat	even	rough
Duvensee 13	SH2017-27.**47**	1	weathered	340	horizontal	flat	partly uneven	rough
Friesack 4		2	good	206/178	horizontal/horizontal	slightly convex/ level	even/~even	smooth/ ~smooth
Rothenklempenow 17	99/77, **1603**	1	lower surface split by heat	329	horizontal	unregular sinuous	uneven	smooth
Rothenklempenow 17	99/77, **599**	4	good	179/184 173/131	horizontal/horizontal slightly inclined/horizontal	flat/flat flat/slightly convex	even/even/ uneven/uneven	smooth/smooth smooth/smooth
Rothenklempenow 17	99/77, **603**	2	good	351/331	horizontal/horizontal	flat/flat	~even/~even	rough/rough

Tab. 2 Surface qualities of stationary anvils (cf. **Fig. 6**).

CHARACTERISTICS OF "STATIONARY STONES" IN DUVENSEE, FRIESACK, ROTHENKLEMPENOW

The majority (77 %) of the heavy stones consists of different varieties of granite. These are easy to procure from the tills close to the sites. Single stationary stones consist of sandstone, quartzite and porphyry (**Tab. 1**). Weathering has faded the colour of most of the stones to a greyish-white. This might also offer an explanation as to why the softer mica minerals on the granite surfaces are often underrepresented or totally missing. The humic acids and the increasing oxygenation of the peats led to the more or less severe degradation of stones, particularly in Duvensee. This is also evident in the comparatively low densities of the stones: granite usually has a density of 2.6-2.7 g/cm^3; here it is generally less (**Tab. 1**).

None of the stones bears evidence of being intentionally prepared for use, e.g., by cracking them into appropriate sizes, slicing them into slabs, or by shaping them laterally; nor are there any hints of intentional maintenance of the stones during use.

Weighing between 1,109 g and 7,600 g (mean weight 2,834 g or 3,442 g, if just compete stones are considered), with a volume between 435 cm^3 and 2,634 cm^3 (mean 1,170 cm^3 or 1,282 cm^3, cf. **Tab. 2**), the stones are clearly set apart from the other GST.

All stones have a compact, more or less prismatic form (except for the fragmented pieces) (**Fig. 1**), with one or two opposed surfaces. Only the "stationary stone" from Friesack shows four surfaces. Altogether 21 potential working surfaces that have been studied here. Their sizes range from 89 cm^2 to 351 cm^2 (**Tab. 2**). To describe the qualities of the presumed working surfaces, four levels of augmenting resolution are used (**Tab. 2**). They include the inclination of the working surfaces (horizontal or inclined) when the stone is placed on the ground, its curvature (flat, concave or convex), the topographic relief (even or uneven), and the micro-topography or roughness (which is mainly dependent on the granularity of the surface: roughness or smoothness) (**Fig. 6**). Most surfaces are oriented horizontally when the stone is placed on the ground, or are at most slightly inclined in single cases, depending also on the underground the stone is positioned. The surfaces of the respective stones are mostly level (76 %), though not necessarily perfectly even (55 %), but show disparities in the form of small depressions or elevations in 9 cases (45 %), resulting either from use or naturally occuring. About half of the surfaces feel rough, while the other half feel more or less smooth. Roughness depends mostly on the rocks natural granularity, and may therefore reflect selection for specific purposes (rough surfaces for grinding and frictional activities). But surface topography also results from use, heating, or weathering. In one case (**Fig. 7**) the surface was clearly smoothed by use. Weathering and heating have damaged the surfaces and increased the roughness of five stones (**Tab. 2**).

FUNCTION OF "STATIONARY STONES": USE-WEAR RESULTS

Macroscopic and low magnification analyses reveal surface alterations on nearly all the stones, which seem to be related to use (**Tab. 3**). Depressions dominate; these seldom form pronounced and regular pits, or single percussion marks on the flat working surfaces. Only three stones show no or only obscure traces, due to their poor surface preservation. Based on this evidence, it is clear that most of the stones have been used passively as anvils for percussive activities. Additionally, three of the stones show percussion marks on the marginal ends, which must result from an alternative use as an active handheld heavy percussion tool. Here, scaled and stepped impact marks form crushed areas that have reduced the ends of the stones.

Site	inventory number (ID)	macro traces	location/arrangement
Duvensee 5	MfV1925.119:012	irregular shallow depression	centre of upper side
Duvensee 8	SH1978-35.**6**	very smoothly abraded/polished with fine striations; groove with deep triations; single impact scars; potential remnant of pit at breaking edge	upper side
Duvensee 8	SH1978-35.**7**	obscure flat depression; obscure impact marks	centre lower side next to breaking edge; scattered over lower and upper side
Duvensee 8	SH1978-35.**8**	long triangular scars/depressions; concentration of impact marks	centre of upper side; upper marginal end
Duvensee 8	SH1978-35.**9**	flat depressions in large-area abrasion? obscure small irregular depressions (low.); crushed areas with scale impact marks	nearly whole upper side; densely scattered on lower surface; marginal ends
Duvensee 8	SH1978-35.**10**	deep notched pit and parallel striations (up.); shallow irregular pits; impact marks; stepped flat flake negatives (low.)	centre of upper side; scattered over lower side and edges
Duvensee 13	SH2017-27.**4**	obscure circular and triangular pits (heat damage?)	scattered over upper and lower side
Duvensee 13	SH2017-27.**9**	not visible	
Duvensee 13	SH2017-27.**47**	large circular pits	on fringe of upper side
Friesack 4		shallow depression; short striation; single impact marks; crushed areas with stepped impacts; deep triangular scars	centre of upper side; marginal ends of short edges
Rothenklempenow 17	99/77, **1603**	obscure striations	centre of upper side
Rothenklempenow 17	99/77, **599**	shallow depression with triangular ection; single notches; parallel triations; scaly detachments	central on upper side; short edge
Rothenklempenow 17	99/77, **603**	shallow pits, circular with rough bottom and irregular with scale bottom; triangular impact marks; half-moon shaped notches	loosely scattered on both flat surfaces, two round pits side by side on lower surface; isolated marks on long edges

Tab. 3 Character and location of use wear on stationary anvils after macroscopic analyses.

Percussion marks on the flat surfaces appear as single cavities or cluster in distinctive, mostly shallow "pits", better described as depressions. These take different shapes and sizes, from a coarse roughening of the surface to deeper triangular notches. However, distinct circular pits with regular abraded surfaces that resemble those on the Mangetti stone described above are rare. Probably the best example (Duvensee 13: ID SH2017-27.**47**) is not appropriate for microscopic analyses, due to its heavily weathered surface. Furthermore, a few surfaces show striations (Duvensee 8: ID SH1978-35.**6**, ID SH1978-35.**10**; Rothenklempenow; ID 99/77, **599**) or short grooves (Friesack) in the immediate vicinities of the pits. Most are very fine,

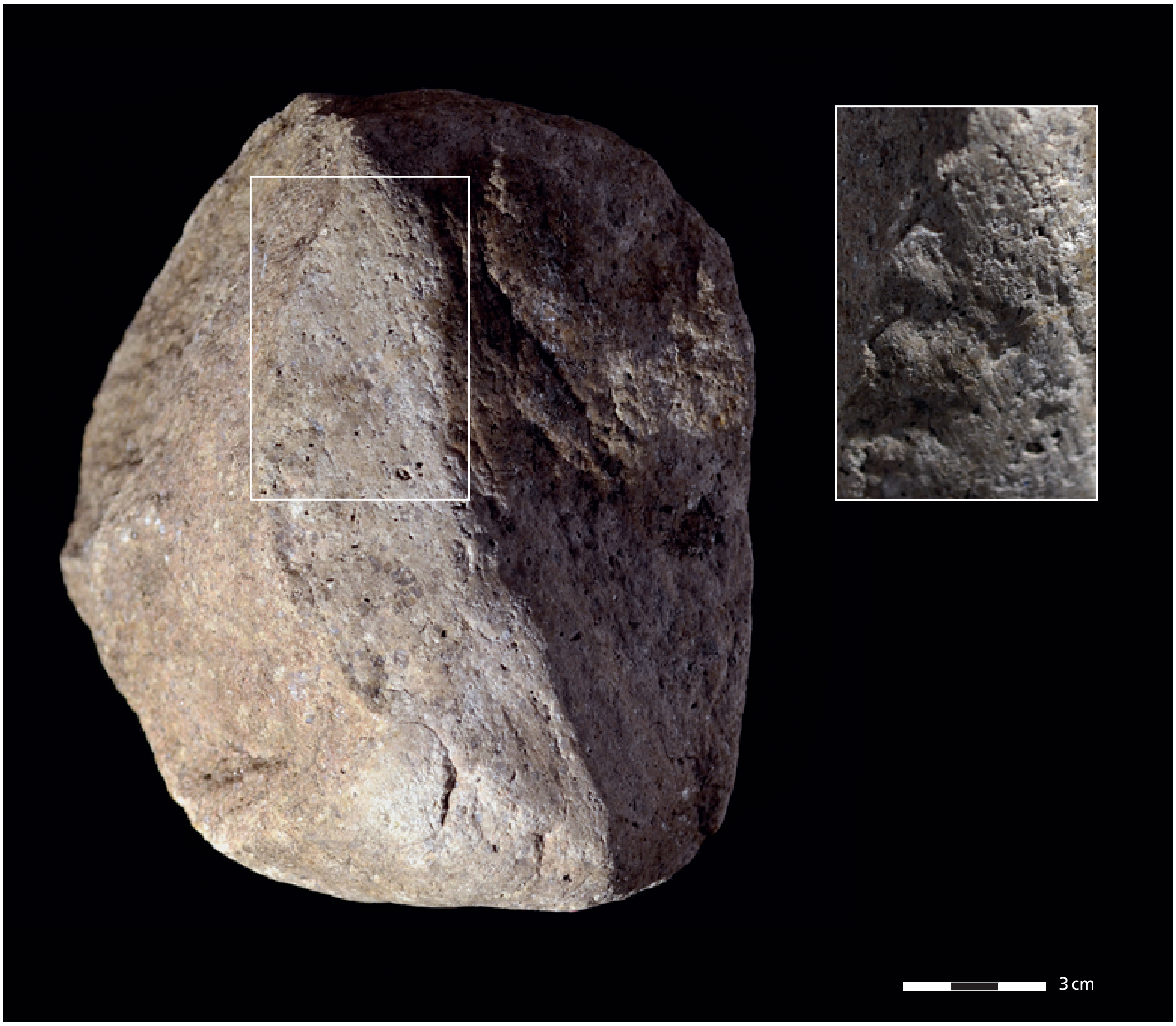


Fig. 7 Duvensee site 8, ID SH1978-35.6. Upper surface with abraded working surface, that probably broke during use. Magnification with parallel striations that indicate motion of use.

macroscopically visible only under grazing light. These striations might document the use of the surfaces for pounding as a combined movement of hitting and dragging. But the stationary stones were occasionally also used for grinding or polishing activities, as is evident on stone ID SH1978-35.6 from Duvensee 8 (Fig. 7). The stone broke into two halves across a working surface, that based on the presence of numerous parallel striations was totally smoothed by abrasion. Beneath the smoothed surface is an irregular groove that may have formed naturally but clearly shows some use-related deep striations inside.

If we compare the macroscopic evidence for use wear, especially the development of pits with those on the Mangetti stones from Namibia, they seem to be only weakly developed. This may have been induced by a variety of factors: the formation of use wear is a product of the raw materials of the stones and of the contact materials, namely the hammer and matter processed. A soft percussion tool like a wooden club or the processing of softer or more pliable organic materials like nuts, seeds, or fresh bone will produce less pronounced impact marks, but can still cause abrasion (de la Torre et al., 2013). On the other hand, there is no shock absorption during such knapping activities as bipolar knapping; this increases the force on the anvil, leading to surface fatigue and fractures, or the loss of grains (cf. Adams, 2014; Dubreuil et al., 2015: 135). Such damage has also been observed during preliminary microscopic investigations on percussion marks on the stones under consideration.

The duration and intensity of use play a prime role in the formation of use wear. This was also observed for the Quandong stones in Australia, where pits start as single percussion marks but deepen with use over time (Pardoe et al., 2019). In this regard it seems likely that the stones under consideration did not have a long and intensive use life. This is further supported by the fact that use wear traces are not densely distributed, but are instead loosely scattered and do not overlap.

CONCLUSIONS

Stationary stones form a distinctive artefact group within GST. These heavy and compact blocks are interpreted as having not been moved around, but instead installed as anvils at places of use. As such they are indicative of land use patterns and subsistence strategies. These changed dramatically – worldwide – at the end of the Pleistocene and the beginning of the Holocene, making the study of these stones particularly interesting for the Mesolithic. To date, little is known about the use of stationary stones in the Mesolithic.

Macroscopic analyses of the stationary stones from Duvensee, Friesack and Rothenklempenow reveal use-wear on nearly all stones, attesting to their use as anvils, but also in abrasive activities and as hammer stones. Other functions (for example, as seats or weights) are of course possible, but would not have left any traces of use. Percussion marks or flat depressions are most common, but all the stones are different, with a lack of use-wear patterns that can be interpreted in terms of repetitive activities. This might point to the versatile function of the stones, or be due to the length of time they were used: the traces are relatively weakly developed, indicating a less intensive use of the stones. However, macroscopic surface analyses are often ambiguous, and so far do not reveal anything about the materials processed on the stones. This requires further verification by microscopic analyses and comparative studies on experimentally used stones as well as on a natural reference collection. On this basis, a quantitative evaluation of use-wear in combination with residue analyses will allow for a reconstruction of the use history and economy of the stones. First microscopic analyses are promising. They document the damage of single grains in the relevant areas, like scars, fractures or even the total crushing of grains, resulting in a frosted appearance (e. g., Adams, 2014).

The find frequencies and settlement contexts of the stones are revealing. By far the majority of heavy stones have been detected at Duvensee *Wohnplatz 8*. In contrast to Friesack and Rothenklempenow, where the whole spectrum of subsistence and crafting activities is documented by an enormous amount of find material, Duvensee *Wohnplatz 8* was just an ephemeral camp, mainly used for hazelnut processing. This speaks in favour of the close connection of these stones to nut processing, among other functions. The Duvensee area was repeatedly occupied and, even though not all sites show the same bulk of nutshells, hazelnut processing was one of the main tasks here, after flint knapping. People returned year after year in a long and stable land use tradition, settling the same places (sites 5, 11) repeatedly, or more frequently chosing a location just a few meters from the previous one. In contrast to the situation in Mangetti described above, stones were abundant in the tills around Duvensee (and at Friesack and Rothenklempenow as well), and their transport could have been facilitated by boats. In this way, people seem to have gradually equipped the lakeshore area with working materials. It remains unclear, of course, whether people reused the stones from previous stays for nut cracking and grinding.

Final remark

My interest on the function of GST was sparked by my former work on the Duvensee sites, the subject matter of my PhD project. At that time, Martin helped with words and deeds, or better still, with data, knowledge, literature, and all his competence and experience. Thank you, Martin, for sharing this with me, and for the inspiring discussions that deepened my fascination for the Mesolithic.

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Daniela Holst
University of Cologne
Institute of Prehistoric Archaeology
Weyertal 125
D - 50931 Köln
d.holst@uni-koeln.de