

<sup>1</sup> Exploring the composition of lithic assemblages in Mesolithic  
<sup>2</sup> south-eastern Norway

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<sup>5</sup> **Abstract**

This paper leverages multivariate statistics to explore the composition of 54 Mesolithic assemblages located in south-eastern Norway. To provide analytical control pertaining to factors such as variable excavation practices, systems for artefact categorisation and raw-material availability, the sites chosen for analysis have all been excavated relatively recently and have a constrained geographical distribution. The assemblages were explored following two strains of analysis. The first of these entailed the use of artefact categories that are established within Norwegian Mesolithic archaeology, while the other involved drawing on measures that have been linked directly to land-use and mobility patterns associated with lithic assemblages more widely. The findings pertaining to the established artefact categories largely reflect the temporal development previously reported in Norwegian Mesolithic research, which has been based on more subjectively driven methods. Furthermore, the chronological trends associated with variables taken from the so-called Whole Assemblage Behavioural Index, originally developed for characterising Palaeolithic assemblages in terms of associated mobility patterns, also align with the development previously proposed in the literature. This provides an initial indication that these measures are applicable in a Norwegian Mesolithic setting as well, setting the stage for a more targeted and rigorous model evaluation outside this exploratory setting. This might ultimately yield a powerful comparative tool for more extensive analyses of Mesolithic assemblages.

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<sup>25</sup> **1 Introduction**

This study employs multivariate exploratory statistics to analyse lithic assemblages associated with a larger number of Mesolithic sites located in south-eastern Norway. This is done to identify latent patterns and structure in the relationship between the assemblages, with the ultimate aim of identifying behaviourally induced variation in their composition across time. However, the composition of the assemblages can be expected to be determined by a multitude of factors (e.g. Dibble et al., 2017; Rezek et al., 2020), ranging from the impact of natural formation processes, to various and intermixed behavioural aspects such as purpose, duration, frequency and group sizes at visits to the sites. The assemblages are also likely to be impacted by variation in lithic technology, artefact function, use-life and discard patterns, as well as procurement strategies and access to raw materials. Finally, analytic and methodological dimensions relating to survey, excavation and classification practices are also fundamental to how the assemblages are defined. Consequently, the analysis conducted here is done from an exploratory perspective, where all of these factors should be seen as potential contributors to any observed pattern. In an attempt to limit the influence of some potentially confounding effects, the material chosen for analysis has a constrained geographical distribution, and stems from recent investigations that have employed comparable methods for excavation and classification within larger unified projects.

Even though each individual assemblage can have been impacted by an virtual infinitude of effects that might skew an archaeological interpretation, this does not preclude the applicability of inductive analyses aimed at revealing overarching structure in the data without imposing overly complex analytical frameworks that attempt to account for these particularities (Bevan, 2015). Structure that can be revealed from considering all of the assemblages in aggregate can constitute a step in an iterative analytical chain that ultimately aims to tease apart the multitude of factors that have shaped the composition of the assemblages, and should be of value to subsequent in-depth studies of any individual site. The most immediate danger of the approach outlined here is rather to be overly naive in the causal significance and cultural importance that is ascribed to any identified pattern. As such, the main aim of this analysis is to compare the results with findings reported in previous literature concerned with the Mesolithic in southern Norway and have the generation of new hypotheses as a possible outcome. To this end, the analysis follows two analytical avenues. The first involves an analysis of the assemblages using the classification of the artefacts done for the original excavation reports. The second involves an analysis of the assemblages in light of the so-called Whole Assemblage Behavioural Index (e.g. Clark and Barton, 2017), which has been employed in other contexts to align properties of lithic assemblages with land-use and mobility patterns.

## 2 Archaeological context and material

The Early Mesolithic, or Flake Axe Phase, is defined as lasting from c. 9200–8200 BCE (Reitan, 2016). The phase is set to start with the first human occupation in Norway which is widely held as originating from southern Scandinavian and northern European regions. This is to be directly reflected by similarities in the artefact inventories (Bang-Andersen, 2012; Bjerck, 2008; Fuglestvedt, 2012; Glørstad, 2016). Previous research has typically proposed that the Early Mesolithic is characterised by a relatively high degree of mobility, and low variation in site types and associated mobility patterns (e.g. Bjerck, 2008; Breivik and Callanan, 2016; Fuglestvedt, 2012; but see *viken2018?*). The transition to the subsequent Middle Mesolithic, or Microlith Phase, at around 8200 BCE has been linked to changes in blade (Damlien, 2016) and subsequently axe technology (Eymundsson et al., 2018; Solheim et al., 2020), which in turn has been associated with changes in population genomics and related migration events hailing from the Eurasian steppes (Günther et al., 2018; Manninen et al., 2021). The radiocarbon record points towards a coinciding population decline in southern Norway around this time (Nielsen, 2021). Although this does not appear to be evident in the regional data for south-eastern Norway, taphonomic loss associated with these early dates is an issue (Nielsen, 2021; Solheim, 2020; Solheim and Persson, 2018). In the chronological framework of Reitan (2016), the Microlith phase is defined as lasting until around 7000 BCE. The Microlith phase is followed by the Pecked Adze Phase, characterised by a more dominating presence of non-flint macro tools and associated production waste in the assemblages (Reitan, 2016). Following Reitan (2016), the next typological transition at c. 5600 BCE signifies the onset of the Nøstvet Adze Phase. While previously defined as having a slightly longer duration, the Nøstvet Phase has traditionally been seen as representing the onset of more varied settlement systems and stable mobility patterns in the Mesolithic of south-eastern Norway (e.g. Jaksland, 2001; Lindblom, 1984). In recent years it has been suggested that the transition to a decrease in mobility and more varied land-use patterns can be traced back to the Middle Mesolithic (Solheim and Persson, 2016). The subsequent Transverse Arrowhead Phase (c. 4500–3900 BCE) is characterised by a dramatic decrease in axe finds, and the introduction of tranverse-, tanged- and single-edged points (Reitan, 2016). It has recently been suggested that a dispersal of people from southern Scandinavia into southern Norway takes place in this period (Eigeland, 2015, p. 379; Nielsen, 2021), which could follow after a preceding population decline at c. 4300 BCE (Nielsen, 2021).

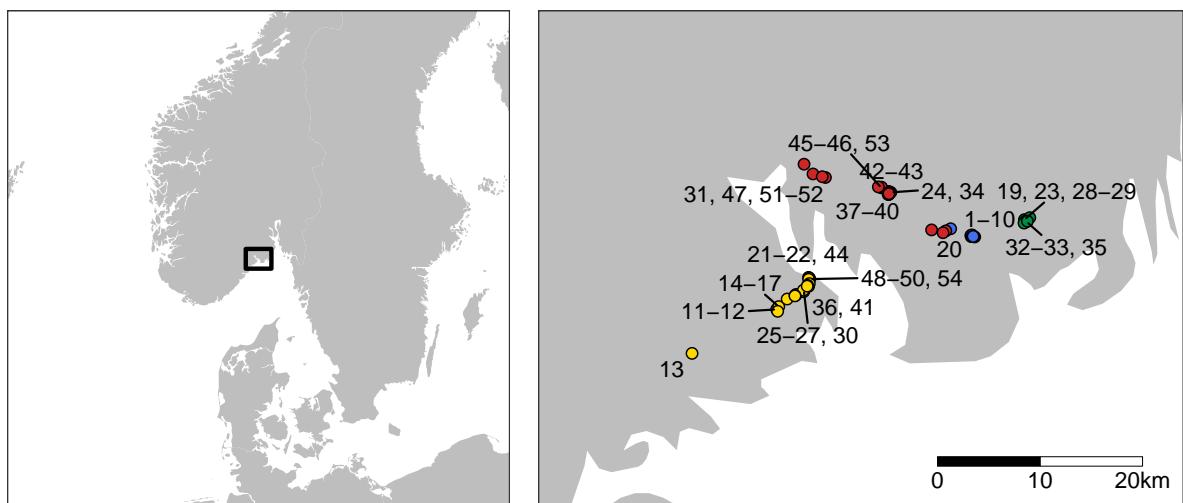
The 54 coastal sites chosen for analysis here have a relatively limited geographical distribution in south-eastern Norway (Figure 1A). The sites were excavated as part of four larger excavation projects that all took place within the last 15 years (Jaksland and Persson, 2014; Melvold and Persson, 2014; Reitan and Persson, 2014; Solheim, 2017a; Solheim and Damlien, 2013). The sites included in the analysis consist of all Mesolithic sites excavated in conjunction with the projects that have assemblages holding more than 100 artefacts. The institution responsible for these excavations was the Museum of Cultural History in Oslo. This has led to a considerable overlap in the archaeological personnel involved, and comparable excavation practices across the

91 excavations. Furthermore, with these projects, major efforts were made to standardise how lithic artefacts  
92 were to be classified at the museum (Koxvold and Fossum, 2017; Melvold et al., 2014). As a result, this should  
93 reduce the amount of artificial patterning in the data incurred by discrepancies in the employed systems for  
94 categorisation (e.g. Clark and Riel-Salvatore, 2006; Dibble et al., 2017). In this setting, for example, bias  
95 could potentially follow from the fact that two of the projects have sites with relatively contemporaneous  
96 dates (Jaksland, 2014; Solheim and Damlien, 2013, see also Figure 1B). Any project-dependent classification  
97 practice could as a consequence lead to an exaggeration of chronological differences between the assemblages.  
98 While this is difficult to fully account for, I do believe that the relative contemporaneity of the excavation  
99 projects, as well as the overlap in excavation and classification practices should minimise the above-mentioned  
100 effects.

101 A defining characteristic of the Norwegian Mesolithic is that a clear majority of the known sites are located in  
102 coastal areas (e.g. Bjerck, 2008). Furthermore, these coastal sites appear to predominantly have been located  
103 on or close to the contemporary shoreline when they were in use (e.g. Åstveit, 2018; Breivik et al., 2018;  
104 Møller, 1987; Solheim et al., 2020). In south-eastern Norway, this pattern is combined with a continuous  
105 regression of the shoreline, following from isostatic rebound (e.g. Romundset et al., 2018; Sørensen, 1979).  
106 The fairly rapid shoreline displacement means that the sites tend not to have retained their strategic or  
107 ecologically beneficial shore-bound location for long periods of time (cf. Perreault, 2019, p. 47). Consequently,  
108 the shore-bound settlement, combined with the rapid shoreline displacement has resulted in a relatively high  
109 degree of spatial separation of cumulative palimpsests, to follow the terminology of Bailey (2007), while the  
110 reconstruction of the trajectory of relative sea-level change allows for a relatively good control of when these  
111 accumulation events occurred. In other parts of the world, a higher degree of spatial distribution means that  
112 while the physical separation of material can help delineate discrete events, this typically comes at the cost of  
113 losing temporal resolution as any stratigraphic relationship between the events is lost (Bailey, 2007). However,  
114 as the rate of isostatic rebound has varied throughout the Mesolithic in the region, and local topography  
115 and bathymetry will have impacted how rapidly a site lost its shore-bound location, this effect is not evenly  
116 distributed in time and space. In the earliest part of the Mesolithic, the displacement rate within the study  
117 area would have been around as much as 8.8 cm/year, falling to around 0.5 cm/year towards the end of the  
118 Mesolithic (Sørensen et al., 2014). Thus, while relative sea-level change appears to have reduced the degree of  
119 mixing that has occurred in the assemblages, it is worth bearing in mind that this could vary depending on  
120 when and where they were in use, potentially reducing the degree to which their composition can be directly  
121 compared.

122 The lithic data analysed here is based on the classification of the site assemblages done for the original  
123 excavation reports, and consists of 48 variables representing differentdebitage and tool types. While the  
124 classification practices for the excavation projects were standardised to an extent, there are some instances  
125 where time was allocated to identify additional artefact sub-categories aimed at answering specific research  
126 questions. Some categories in the original reports have therefore been combined in the dataset. For example,  
127 this pertains to the category narrow-blades (width > 8mm and < 12mm), which was only separated from  
128 (macro-)blades (width  $\geq$  12 mm) and micro-blades (width  $\leq$  8 mm) for some of the sites. Narrow-blades were  
129 combined with the blade category here. Furthermore, the artefact data have here been divided into flint and  
130 non-flint materials. Flint does not occur indigenously in Norway, and is only available locally as nodules that  
131 have been transported and deposited by retreating and drifting ice (e.g. Berg-Hansen, 1999). This means  
132 that the distribution and quality of flint has been impacted by a diverse set of factors relating to climatic and  
133 geographical factors such as, but not limited to, topographic variability, shoreline morphology and ocean  
134 currents (Eigeland, 2015, p. 46). Thus, while flint is treated as a unified category here, the variability in  
135 quality could have been substantial (Eigeland, 2015, pp. 45–53). Furthermore, the various non-flint raw  
136 materials that have been lumped together have quite disparate properties, where fine-grained cryptocrystalline  
137 materials are often used as a substitute or supplement to flint, while other, coarser materials are usually  
138 associated with the production of axes and other macro tools. Given this differentiated use, these raw-material  
139 properties are expected to be reflected in the retaineddebitage and tool categories. An important benefit of  
140 combining all of the non-flint materials is that this reduces the dependency on whether or not these have been  
141 correctly and consistently categorised for the reports (cf. Frivoll, 2017). While certainly a topic deserving  
142 of more attention, the general sentiment in the literature is that there would have been stable access to  
143 locally available non-flint raw-materials of good quality in south-eastern Norway (e.g. Eigeland, 2015, p.

A



B

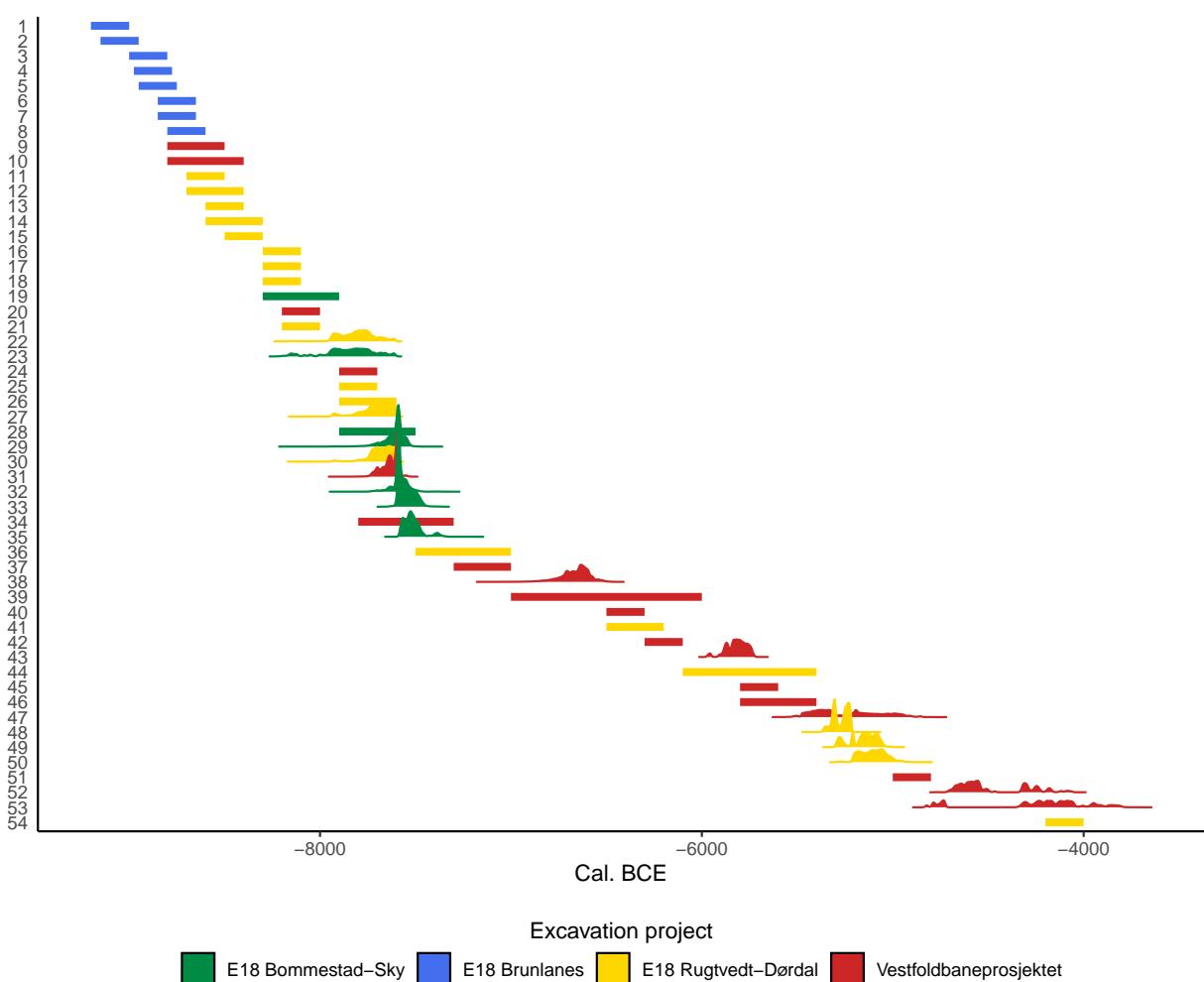


Figure 1: A) Spatial and B) temporal distribution of the sites chosen for analysis. Radiocarbon age determinations are given as the sum of the posterior density estimates. Solid lines indicate that the site has been dated with reference to relative sea-level change and typological indicators. These follow the original reports.

<sup>144</sup> 370; Glørstad, 2011). Finally, while factors such as landscape changes through shoreline displacement can  
<sup>145</sup> have led to variable raw-material availability at the analysed sites, their relatively constrained geographical  
<sup>146</sup> distribution hopefully counteracts some non-behavioural sources of variation.

Table 1. Analysed sites.

no	Site name	Dating method	Reported start (BCE)	Reported end (BCE)
1	Pauler 1	Shoreline/typology	9200	9000
2	Pauler 2	Shoreline/typology	9150	8950
3	Pauler 3	Shoreline/typology	9000	8800
4	Pauler 5	Shoreline/typology	8975	8775
5	Pauler 4	Shoreline/typology	8950	8750
6	Pauler 6	Shoreline/typology	8850	8650
7	Bakke	Shoreline/typology	8850	8650
8	Pauler 7	Shoreline/typology	8800	8600
9	Nedre Hobekk 2	Shoreline/typology	8800	8500
10	Solum 1	Shoreline/typology	8800	8400
11	Tinderholt 3	Shoreline/typology	8700	8500
12	Tinderholt 2	Shoreline/typology	8700	8400
13	Dørdal	Shoreline/typology	8600	8400
14	Tinderholt 1	Shoreline/typology	8600	8300
15	Skeid	Shoreline/typology	8500	8300
16	Hydal 3	Shoreline/typology	8300	8100
17	Hydal 4	Shoreline/typology	8300	8100
18	Hydal 7	Shoreline/typology	8300	8100
19	Hovland 2	Shoreline/typology	8300	7900
20	Nedre Hobekk 3	Shoreline/typology	8200	8000
21	Hydal 8	Shoreline/typology	8200	8000
22	Hegna vest 1	Radiocarbon	8000	7800
23	Hovland 5	Radiocarbon	8000	7700
24	Sundsaasen 1	Shoreline/typology	7900	7700
25	Hegna øst 6	Shoreline/typology	7900	7700
26	Hegna vest 4	Shoreline/typology	7900	7600
27	Hegna vest 2	Radiocarbon	7900	7550
28	Nordby 2	Shoreline/typology	7900	7500
29	Hovland 4	Radiocarbon	7900	7500
30	Hegna vest 3	Radiocarbon	7800	7600
31	Prestemoen 1	Radiocarbon	7700	7600
32	Hovland 1	Radiocarbon	7700	7400
33	Hovland 3	Radiocarbon	7650	7450
34	Gunnarsrød 7	Shoreline/typology	7800	7300
35	Torstvet	Radiocarbon	7500	7100
36	Hegna øst 5	Shoreline/typology	7500	7000
37	Gunnarsrød 8	Shoreline/typology	7300	7000
38	Langangen Vestgård 1	Radiocarbon	6800	6600
39	Gunnarsrød 2	Shoreline/typology	7000	6000
40	Gunnarsrød 6b	Shoreline/typology	6500	6300
41	Hegna øst 7	Shoreline/typology	6500	6200
42	Gunnarsrød 6a	Shoreline/typology	6300	6100
43	Gunnarsrød 4	Radiocarbon	6000	5800
44	Stokke/Polland 3	Shoreline/typology	6100	5400
45	Gunnarsrød 10	Shoreline/typology	5800	5600
46	Langangen Vestgård 2	Shoreline/typology	5800	5400
47	Vallermyrene 4	Radiocarbon	5500	5200
48	Hegna øst 2	Radiocarbon	5350	5200

49	Stokke/Polland 8	Radiocarbon	5300	5200
50	Stokke/Polland 5	Radiocarbon	5300	5000
51	Prestemoen 2	Shoreline/typology	5000	4800
52	Vallermyrene 1	Radiocarbon	4700	4100
53	Langangen Vestgård 3	Radiocarbon	4350	4000
54	Stokke/Polland 9	Shoreline/typology	4200	4000

### 147 3 The analysis of lithic assemblages

148 Studies concerned with chronological changes in the composition of lithic assemblages in southern Norway  
 149 have typically had a focus on morphological variation among artefacts (e.g. Ballin, 1999; Bjerck, 1986;  
 150 Reitan, 2016) or been concerned with technological processes associated with certain sub-categories of the site  
 151 inventories, such as the production of blades or axes (e.g. Berg-Hansen, 2017; Damlien, 2016; Eymundsson et  
 152 al., 2018; Solheim et al., 2020). Studies that have involved entire assemblages have either been concerned with  
 153 general compositional traits such as relative frequency of various tool types and raw-materials (Breivik, 2020;  
 154 Breivik and Callanan, 2016; Reitan, 2016; Viken, 2018), or involved extremely in-depth studies of technological  
 155 organisation associated with a handful of assemblages (Eigeland, 2015; Fuglestvedt, 2007; Mansrud and  
 156 Eymundsson, 2016). These studies are, however, based on narratively driven methods, leaving the weighting  
 157 of the different variables for the final interpretations unclear. To my knowledge, only a single study dealing  
 158 with the composition of Mesolithic assemblages in southern Norway has involved the use of a multivariate  
 159 quantitative framework, which was employed to structure the analysis of eight Middle Mesolithic assemblages  
 160 (Solheim, 2013; see Glørstad, 2010, pp. 145–146 for a spatial application). In sum then, previous studies  
 161 have typically either been limited to a small number of sites, to a subset of the inventories, to morphological  
 162 characteristics, or to subjectively and narratively driven methods that are difficult to scale and consistently  
 163 balance in the comparison of a larger number of artefact categories and assemblages.

164 The aim of the first of part of the analysis is to evaluate the degree to which the composition of the assemblages  
 165 align with patterns that have been suggested by earlier studies of the Mesolithic in southern Norway that  
 166 have employed more informally driven methods. This consequently assumes that the artefact categories  
 167 employed in Norwegian Stone Age archaeology are, at least to a certain extent, behaviourally meaningful.  
 168 However, the approach taken is also partially informed by the so-called Frison effect (Jelinek, 1976), which  
 169 pertains to the fact that lithics studied by archaeologists can have had long and complex use-lives in which  
 170 they took on a multitude of different shapes before they were ultimately discarded. Several scholars have built  
 171 on this to argue that morphological variation in retouched lithics from the Palaeolithic cannot be assumed to  
 172 predominantly be the result of the intention of the original knapper to reach some desired end-product, but  
 173 rather that what is commonly categorised as discrete types of artefacts by archaeologists can instead in large  
 174 part be related to variable degrees of modification through use and rejuvenation (e.g. Barton, 1991; Barton  
 175 and Clark, 2021; Dibble, 1995).

176 However, for the most part we lack even a most basic understanding of what any individual lithic object  
 177 in an assemblage has been used for (Dibble et al., 2017). For example, a vast amount of artefacts defined  
 178 as debitage are likely to have fulfilled the function of tools, and both debitage and formal tool types could  
 179 have had various different purposes and had a multitude of shapes throughout their use-life. While use-wear  
 180 analysis could potentially offer a way to identify what artefacts were used for towards the end of their use-life,  
 181 these kinds of analyses are extremely time-consuming and are therefore typically only conducted on a smaller  
 182 number of artefacts that have already been selected for analysis based on their shape (e.g. Solheim et al.,  
 183 2018). Thus, while these analyses can potentially get at in-group variation pertaining to the end-state of a  
 184 group of artefacts, they do not tell us whether or not their classification as a unified group is meaningful in  
 185 the first place (Dibble et al., 2017). As a consequence, the second part of the analysis employs a suite of  
 186 measures developed for the classification of lithic assemblages with these inferential limitations in mind (see  
 187 Barton et al., 2011; Clark and Barton, 2017, and below). The logic behind these measures are founded on an  
 188 understanding of technology as being organised along a continuum ranging between curated and expedient  
 189 (Binford, 1979, 1973; Binford, 1977). An expedient technological organisation pertains to the situational

190 production of tools to meet immediate needs, with little investment of time and resources in modification and  
191 rejuvenation, resulting in high rates of tool replacement. Curated technological organisation, on the other  
192 hand, has been defined as related to manufacture and maintenance of tools in anticipation of future use, the  
193 transport of these artefacts between places of use, and the modification and rejuvenation of artefacts for  
194 different and changing situations.

195 However, following not least from the ambiguous definition first put forward by Binford (1973), the theoretical  
196 definition of curation, its archaeological correlates, and behavioural implications have been widely discussed  
197 and disputed, and no single definition has ever been reached (e.g. Bamforth, 1986; Nash, 1996; Shott, 1996;  
198 Surovell, 2009, pp. 9–13). The continuum between curated and expedient technology has for example been  
199 related to dimensions such as land-use and mobility strategies and raw-material quality and availability (e.g.  
200 Andrefsky, 1994; Clark and Barton, 2017; Kuhn, 1992; Parry and Kelly, 1987; Smith, 2015). Still, that the  
201 distinction can offer a useful analytical point of departure if clearly and explicitly operationalised seems more  
202 or less agreed upon, and some dimensions of the concept are generally accepted. For example, although  
203 precisely how it is measured may vary, the empirical correspondent to a curated technological organisation is  
204 typically defined by high degrees of retouch, as this is commonly seen as a means of realising the potential  
205 utility of a tool — or extending its use-life — by the repeated rejuvenation and modification of edges (e.g.  
206 Bamforth, 1986; Dibble, 1995; Shott and Sillitoe, 2005).

207 Furthermore, one concrete operationalisation of the terms have been forwarded by Barton (1998) and colleagues  
208 (e.g. Barton et al., 2013, 2011, 1999; Barton and Riel-Salvatore, 2014; Clark and Barton, 2017; Riel-Salvatore  
209 and Barton, 2007; Riel-Salvatore and Barton, 2004; Villaverde et al., 1998), who through a series of studies  
210 have shown that the relationship between volumetric density of lithics and relative frequency of retouched  
211 artefacts in lithic assemblages have a consistent negative relationship across a wide range of chronological  
212 and cultural context, ranging from Pleistocene and Holocene assemblages in Europe and Asia, to assemblages  
213 associated with both Neanderthals and modern humans (Barton et al., 2011; Riel-Salvatore et al., 2008).  
214 This relationship is taken to reflect degree of curation, and is in turn mainly to follow from the accumulated  
215 nature of land-use and mobility patterns associated with the assemblages (Barton and Riel-Salvatore, 2014).  
216 In this model, higher degree of mobility would mean a higher dependency on the artefacts and the material  
217 people could bring with them, and dimensions such as weight, reliability, repairability, and the degree to  
218 which artefacts could be manipulated to fulfil a wide range of tasks are therefore assumed to have been factors  
219 of concern. From this it follows that the empirical expectation for short-term camps is a curated technological  
220 organisation with higher relative frequency of retouched artefacts, and a lower overall density of lithics (Clark  
221 and Barton, 2017). More time spent in a single location, on the other hand, is assumed to lead to better  
222 control of raw-material availability and to allow for its accumulation. This should in turn lead to a more  
223 expedient technological organisation with reduced necessity for the conservation of lithics and extensive use of  
224 retouch. The empirical expectation for lower degree of mobility is therefore relatively high density of lithics,  
225 a low relative frequency of retouched artefacts, as well as a higher number of cores and unretouched flakes  
226 and blades. These variables and underlying logic constitute what has been termed the whole assemblage  
227 behavioural index (WABI, Clark and Barton, 2017), and is the main framework adopted here.

228 However, as these measures are argued to predominantly be determined by land-use and mobility patterns,  
229 relative frequency of chips and relative frequency of non-flint material are also included in the analysis, as  
230 these measures have also been linked to mobility patterns and is of central importance in Norwegian Stone  
231 Age archaeology (e.g. Bicho and Cascalheira, 2020; Breivik et al., 2016; Kitchel et al., 2021; Reitan, 2016) —  
232 the use of local non-flint material has been taken to indicate reduced mobility and increased familiarity with  
233 local surroundings (Glørstad, 2010, p. 181; Jakslund, 2001, p. 112).

## 234 4 Methodology

235 The relatively constrained geographical distribution of the analysed sites, the limited temporal range over which  
236 they were investigated, as well as the methodological equivalency across excavation projects hopefully leads  
237 to an exclusion of some biases that might otherwise skew an exploratory analysis, rendering it more likely that  
238 behaviourally meaningful patterns are identified. However, the exploratory perspective means that a wide range

239 of combinations and transformations of variables has been explored to identify patterning in the data. While  
240 only parts of this process can sensibly be reported here, the data and employed R programming script is freely  
241 available as a research compendium on GitHub (<https://github.com/isakro/exploring-assemblages-se-norway>)  
242 and Zenodo ([placeholder]), following Marwick et al. (2018), allowing readers to explore and scrutinise  
243 the data and the final analytical choices made (Marwick, 2017). However, this inductive data-dredging or  
244 pattern-searching approach does constitute a limited inferential framework (Clark, 2009), as it involves a *post*  
245 *hoc* accommodation of explanations to meet the observed data—data that is both selectively and subjectively  
246 reported upon. The process can still provide the identification of empirical patterns with respects to the  
247 employed units of analysis, which in turn can form the basis for social and behavioural hypotheses. This  
248 can lay the foundation for a deductive research agenda with targeted model evaluation for which clear test  
249 implications can be derived (Clark, 2009, p. 29).

250 The 54 analysed sites have been dated by reference to relative sea-level change, typology and/or radiocarbon  
251 dates (Table 1). Date ranges for sites based on shoreline displacement and typology are taken from the original  
252 reports and follow the evaluation done by the original excavators. Where radiocarbon age determinations  
253 believed to be associated with the lithic material are available, these have been calibrated using the IntCal20  
254 calibration curve (Reimer et al., 2020) and subjected to Bayesian modelling using OxCal v4.4.4 (Bronk  
255 Ramsey, 2009) through the oxcAAR package (Hinz et al., 2021) for R (R Core Team, 2020). The only  
256 constraint imposed for the modelling of the dates was that the dates from each site are assumed to represent  
257 a related group of events through the application of the Boundary function (Bronk Ramsey, 2021). The  
258 resulting posterior density estimates were then summed for each site. Radiocarbon data is provided in the  
259 supplementary data, and has also been collated and reported by Solheim (2020).

260 The first part of the analysis of the lithic data involves employing the method of correspondence analysis  
261 (CA), using the lithic count data as classified for the original excavation reports. As this part of the analysis  
262 partially draws on the above-mentioned Frison effect, several artefact categories have been collapsed for the  
263 CA. A full overview of the aggregated variables and their constituent parts is provided in the supplementary  
264 material. An underlying assumption is therefore effectively that the retained categories represent artefact  
265 categories that have fulfilled different purposes or are related to different technological processes. While  
266 aggregating artefact categories in this manner could potentially subsume important variation, it does also  
267 reduce the possibility that any conclusions are not simply the result of employing erroneous units of analysis.

268 In sum, the variables employed in the analysis are relative frequency of secondarily worked lithics (RFSL),  
269 defined as the number of retouched or ground lithics divided by the assemblage total; volumetric density of  
270 lithics (VDL), defined as number of artefacts per excavated m<sup>3</sup>; relative frequency of chips, defined as the  
271 proportion of artefacts with size < 0.1 cm; relative frequency of cores, simply the proportion of all artefacts  
272 classified as cores in the original reports; relative frequency of blanks, here defined as the proportion of all  
273 artefacts classified as flakes, blades, micro-blades or fragments; and finally relative frequency of non-flint  
274 material. Following Bicho and Cascalheira (2020), the analysis is done using principal components analysis  
275 (PCA), leading to a shift in focus from the relative composition emphasised by the CA, to having more weight  
276 placed on patterning in the most abundant occurrences (Baxter, 1994, pp. 71–77, 103).

277 A note should also be made on the fact that a few variables that are sometimes invoked for the classification  
278 of sites in terms of associated mobility patterns are omitted here (e.g. Bicho and Cascalheira, 2020; Breivik et  
279 al., 2016). For the assemblage data itself this especially pertains to diversity in tool-types (see also Canessa,  
280 2021), which has been omitted in light of the Frison effect. Some site specific aspects such as number of  
281 features has also been disregarded as taphonomic loss is likely to have led to a chronological bias in their  
282 preservation. Similarly, the number of activity areas, effectively number of artefact clusters, however defined,  
283 has also been disregarded. This follows most notably from the fact that the impact of post-depositional  
284 processes at Stone Age sites in Norway is arguably understudied (Jørgensen, 2017). This pertains for example  
285 to the impact of bio-turbation in the form of three-throws, which can have a detrimental effect on the original  
286 distribution of artefacts, and which can be expected to have been relatively frequent on several of the sites  
287 treated here (Darmark, 2018; Jørgensen, 2017).

288    **5    Results**

289    The general impression from the CA is that a chronological dimension is associated with the patterning in  
290    the data (Figure 2). This is indicated by the general transition across the colour scale in the row plot (Figure  
291    2A), combined with the fact that the two first dimensions of the CA accounts for as much as 80.53 % of the  
292    inertia or variance in the data, as well as the horseshoe curve or Guttman effect evident in the column plot  
293    (see Baxter, 1994, pp. 119–120). The earliest sites tend to be located in the upper left corner of plot A, with  
294    increasingly younger sites towards the bottom along the second dimension. Although fewer in number, the  
295    sites from the later parts of the Mesolithic are drawn out along the first dimension of the plot, and are not as  
296    impacted by the second dimension as the more numerous older sites.

297    The column plot (Figure 2B) reveals that the earliest sites are characterised by the flint artefact categories  
298    microburins, projectiles, as well as flint macro tools and associateddebitage. It is also interesting that these  
299    sites to a larger extent are characterised by core fragments, both in flint and non-flint materials, rather than  
300    the cores themselves. The non-flint material on the earliest, or among the earliest sites, appears to be centred  
301    around the production of projectiles, as both the projectiles themselves and non-flint blades are important  
302    constituents of the assemblages at these sites. Site number 9, Nedre Hobekk 2, located in the upper right  
303    quadrant of the row plot represents a somewhat curious case in that its assemblage is dominated by axe  
304    production in metarhyolite (Eigeland, 2014). However, as the site had been quite heavily impacted by modern  
305    disturbances, this led Eigeland (2014, p. 124) to suggest that the material might have been compromised.  
306    This could explain its position as an outlier in the plot. The use of metarhyolite for the production of axes is  
307    present at other contemporary sites as well (Jaksland and Fossum, 2014), but is evidently not as prominent a  
308    part of these assemblages. In sum, the findings for the earliest sites are in large part in line with previous  
309    research (e.g. Bjerck, 2017; Breivik et al., 2018; Damlien and Solheim, 2018; Fuglestvedt, 2007; Jaksland and  
310    Fossum, 2014).

311    The first dimension, which is pulling some of the later sites towards the right of the plot, is mainly defined  
312    by macro tools and associateddebitage in non-flint materials that are negatively correlated with more flint  
313    dominated assemblages. Sites with high values on the first dimensions are later Mesolithic sites associated  
314    with axe production in non-flint materials, but the later sites occur along the entire dimension, indicating  
315    that while these axe production sites are a feature of the later Mesolithic, there is marked variation among  
316    the sites. Although the sample size is quite strained and the discussion of finer chronological points might  
317    not be warranted, the first dimension does appear to be of less importance for the absolute latest sites,  
318    as indicated by their location to the left of the plot. This could indicate that specialised axe production  
319    sites disappear towards the end of the Mesolithic, a notion that would be in line with previous research (e.g.  
320    Eigeland, 2015, p. 370; Glørstad, 2011; Reitan, 2016).

321    As most of the variation in the data is accounted for by the dominating non-flint material in later assemblages,  
322    this suppresses and makes it difficult to discern patterns in the flint data. A second CA was therefore run  
323    excluding the non-flint material (Figure 3). While not as substantial, there is clear temporal patterning in  
324    the flint data as well. This is most marked for the very earliest sites which are pulled away from the main  
325    cluster, as projectiles, microburins, macro tools,debitage from their production, and flakes characterises these  
326    sites. Slightly younger sites appear more impacted by core fragments and blades. The temporal transition  
327    in the main cluster is not as marked, but clearly present, and is driven by a larger proportion of blades,  
328    flakes and small tools in the earliest assemblages of the cluster, which is opposed to chips, fragments and  
329    partly micro-blades. Apart from the impact of core fragments, which is not always highlighted, this must be  
330    considered very much in agreement with previous research (e.g. Solheim, 2017b, with references). A marked  
331    presence of core fragments has, however, previously been noted as one of several similarities between Early  
332    Mesolithic Norwegian sites and Late Palaeolithic sites from continental Europe (Fuglestvedt, 2007; see also  
333    Bjerck, 2017). Overall, the comparatively limited impact of the flint material can possibly be the result of the  
334    aggregation of categories that leads to an suppression of otherwise temporally distinct patterns, and there  
335    are certainly technological nuances in the flint material that is temporally contingent but not recorded during  
336    a regular classification of the material (e.g. Damlien, 2016; Eigeland, 2015; Fuglestvedt, 2007; Solheim et  
337    al., 2020). However, while the former pertains to the analytical trade-off between robustness and sensitivity,  
338    the latter is likely to be true for the non-flint material as well (Eigeland, 2007). The overall pattern does

339 speak to the impact the properties of the raw-material has for the general composition of the assemblages (cf.  
340 Manninen and Knutsson, 2014).

341 Moving on to the PCA of measures that have been linked to mobility, some of the variables with severely  
342 skewed distributions were initially transformed. These are displayed in the correlation matrix in Figure 4.  
343 Figure 5 displays the resulting PCA. There is a general temporal transition from older to younger sites from  
344 the upper left to the bottom right of the plot. The second dimension is mainly defined by a negative correlation  
345 between the VDL and RFSL (Figure 6). Almost orthogonal to this is the strong negative correlation between  
346 relative frequency of chips and blanks. While there is a slight tendency for blanks to be more associated with  
347 younger sites, frequency of chips appears to be largely independent of time. However, the almost suspiciously  
348 strong negative correlation between chips and blanks can perhaps have a practical explanation. Seeing as  
349 the frequency of non-flint material is positively correlated with blanks and negatively correlated with chips  
350 (Figure 4), one explanation to this pattern could be that smaller non-flint pieces are simply more difficult  
351 to identify and separate from naturally fragmented stone during excavation and classification. This could  
352 conceivably have led to an over-representation of blanks as compared to chips in assemblages with a high  
353 proportion of non-flint material. While this is not necessarily the entire explanation behind the relationship,  
354 this does make it difficult to place much analytical weight on this pattern. Relative frequency of cores is not  
355 especially impactful in the PCA, and appears to be independent the temporal dimension as well. That is not  
356 to say that cores may not be indicative or related to mobility patterns, but to get at this may require further  
357 analysis beyond their simple classification as cores (Kitchel et al., 2021).

358 Thus, while some secondary expectations of the WABI does not seem to apply to the present material, it is  
359 difficult to say to what degree this is caused by idiosyncrasies in the Norwegian system for classification of  
360 lithics and properties of the lithic material itself. The relationship between VDL and RFSL does correspond  
361 to the model and follows a clear temporal trend that is also correlated with the increased use of local raw  
362 material. Thus, if the relationship between VDL and RFSL is accepted as a proxy for curation, and is related  
363 to land-use and mobility patterns, these findings would be in line with previous research into the Mesolithic of  
364 Norway, indicating that earlier sites are associated with higher degree of mobility than sites from later phases  
365 (e.g. Bergsvik, 2001; Bjerck, 2008; Glørstad, 2010; Jaksland, 2001). To explore this proposition further, these  
366 two variables are subjected to more detailed scrutiny below.

367 Figure 7A illustrates the negative correlation between the two variables ( $r = -0.5$ ) while also displaying a  
368 general tendency for younger sites to be associated with a higher volumetric density of lithics and a lower  
369 relative frequency of secondarily worked lithics than older sites. The linear correlation is stronger between the  
370 mean site age and RFSL ( $r = -0.51$ ), than between mean site age and VDL ( $r = 0.22$ ). As variable non-flint  
371 availability and workability has also been suggested to potentially impact these dimensions (Manninen and  
372 Knutsson, 2014), Figure 7B displays the same relationship, but exclusively for the flint data. While the  
373 negative correlation is slightly less marked when only the flint data is considered ( $r = -0.4$ ), the general  
374 pattern is the same. The relationship between mean site age and relative frequency of secondarily worked  
375 flint is even stronger ( $r = -0.57$ ), but as indicated by the more spread out distribution along the x-axis, the  
376 volumetric density of flint is not temporally contingent ( $r = 0.1$ ). As was also indicated by the CA, this  
377 follows from the fact that non-flint materials make up a higher share of the assemblages for some of the later  
378 Mesolithic sites, and is a point returned to below where the temporal dimension of the relationship between  
379 VDL and RFSL is explored further.

380 To get more directly at this temporal trend, a curation index based on VDL and RFSL was devised by first  
381 performing a min-max normalisation of the two variables, scaling them to take on values between 0 and 1.  
382 The values for artefact density was then made negative to reflect its relationship with degree of curation. The  
383 mean was then found for each site on these two normalised values. To account for the temporal uncertainty  
384 associated with the dating of the sites, a simulation-based approach was also adopted (e.g. Baxter and Cool,  
385 2016; Crema, 2012; Orton et al., 2017). A LOESS curve was fit to the curation index and site age for each  
386 simulation run, where the age of each site was drawn as a single year from the date ranges associated with the  
387 sites as provided in Figure 1. For sites with radiocarbon age determinations the dates were drawn from the  
388 associated summed posterior density estimates, while ages for sites dated with reference to relative sea-level  
389 change and typology were drawn uniformly from the associated date range. This simulation was repeated  
390 1000 times, the results of which is visualised in Figure 8A. Disregarding the edge-effects at either end of

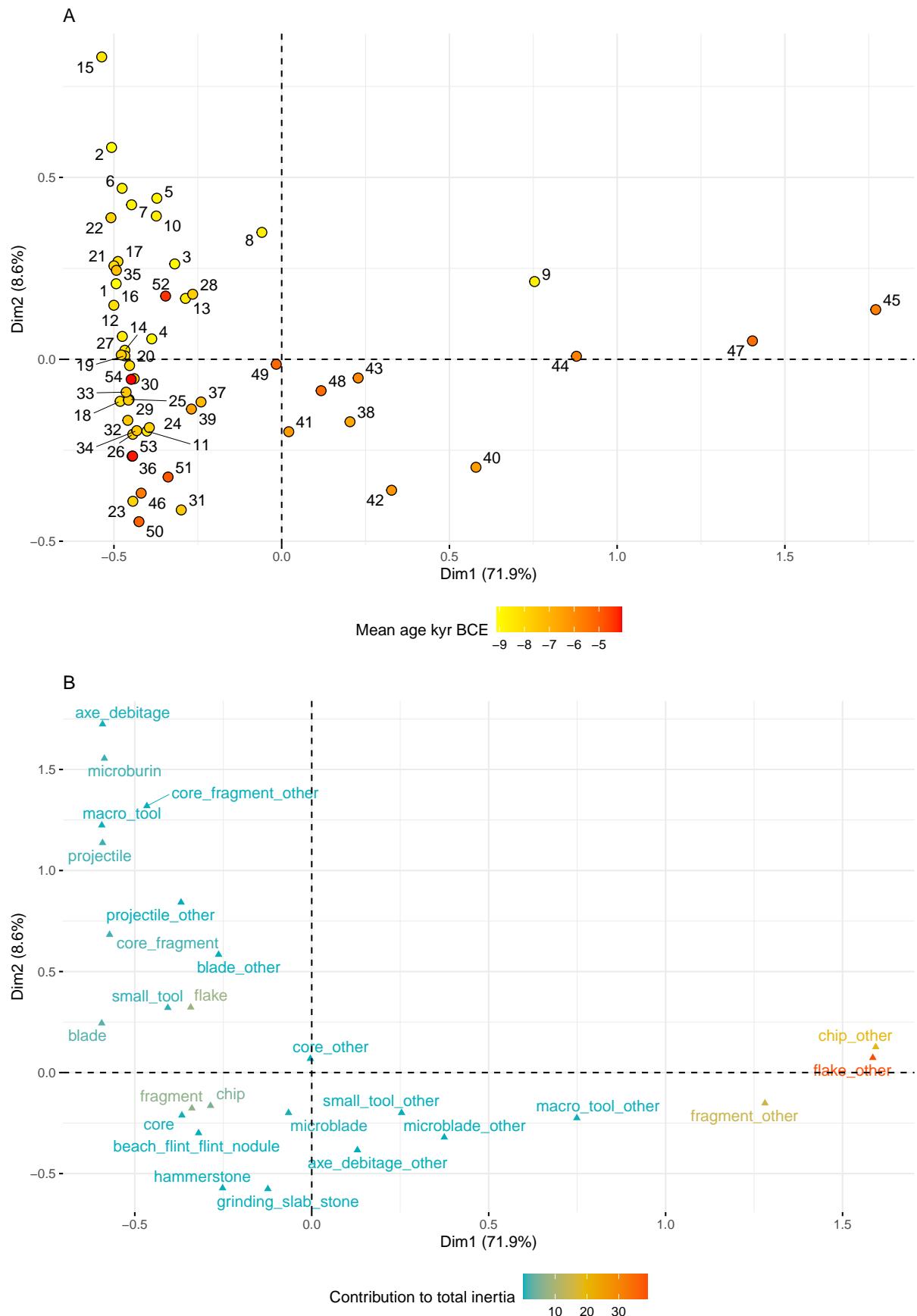


Figure 2: Correspondence analysis using the artefact count data. A) Row plot, B) Column plot.

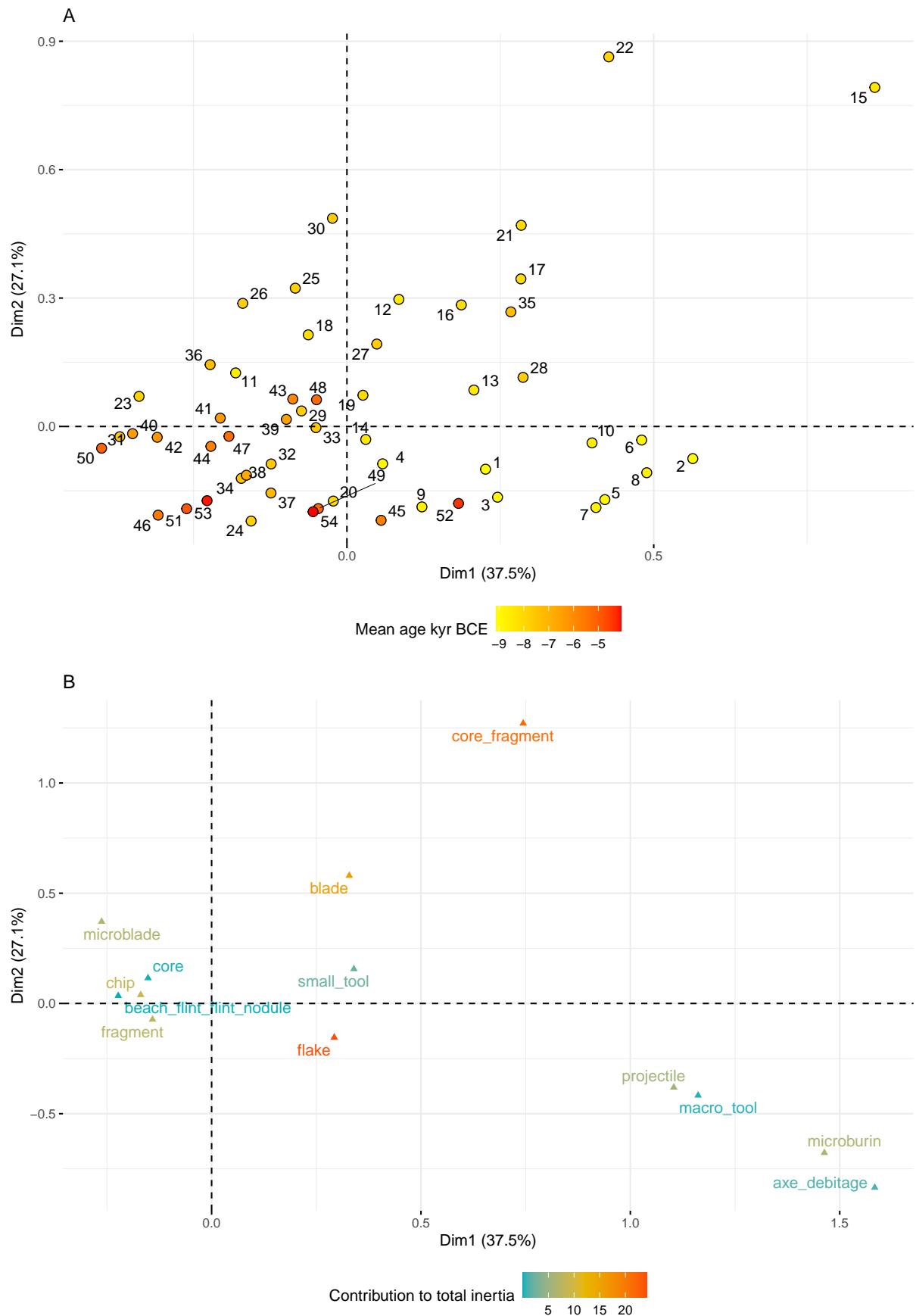


Figure 3: Correspondence analysis using the flint data. A) Row plot, B) Column plot.

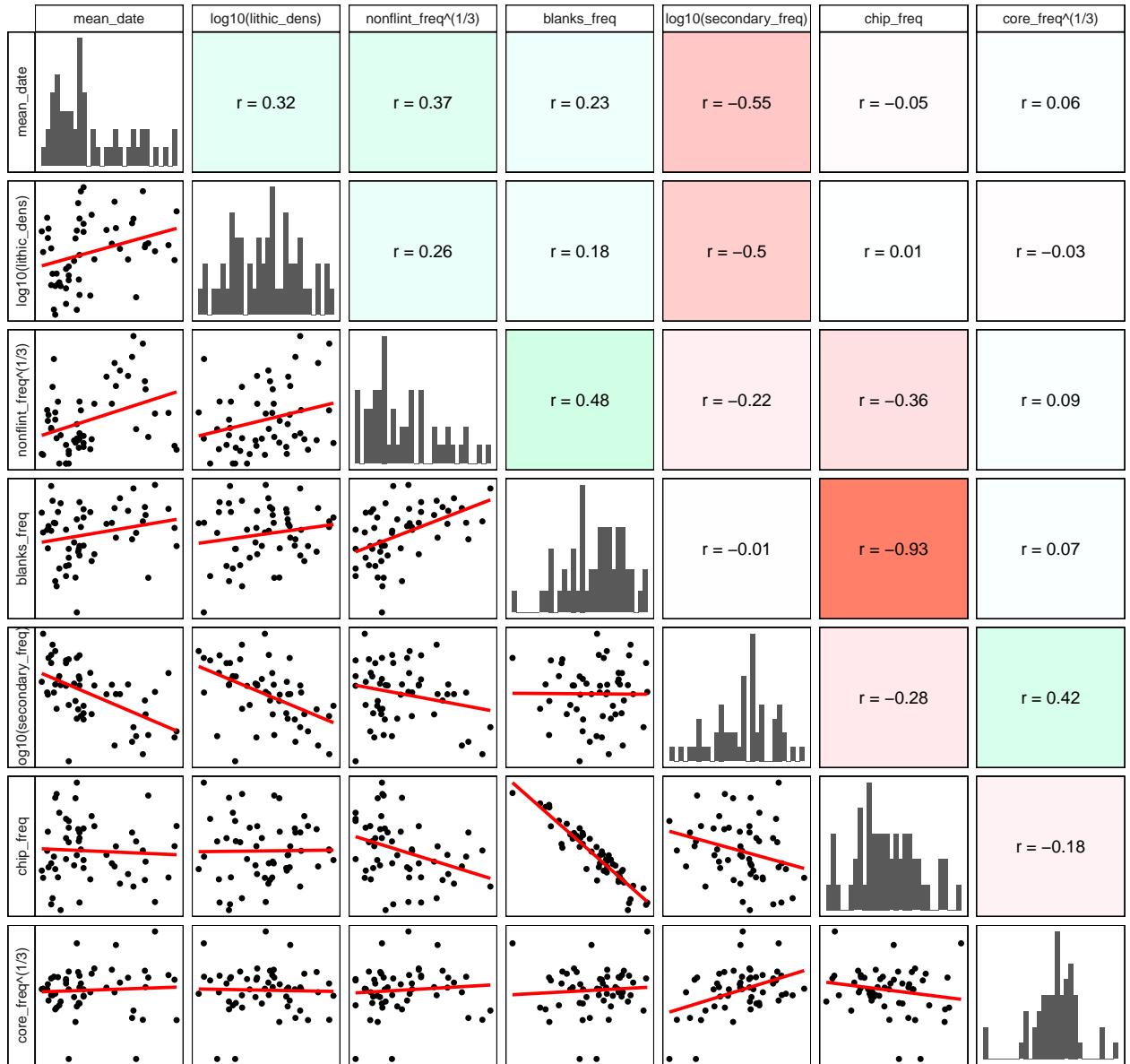


Figure 4: Correlation matrix showing transformation of skewed variables for the PCA. The mean age of the sites has also been included to visualise overall temporal trends. Cells below the diagonal display the bivariate distributions with a fitted OLS-regression. The cells above the diagonal display and are coloured by the corresponding Pearson's correlation coefficient.

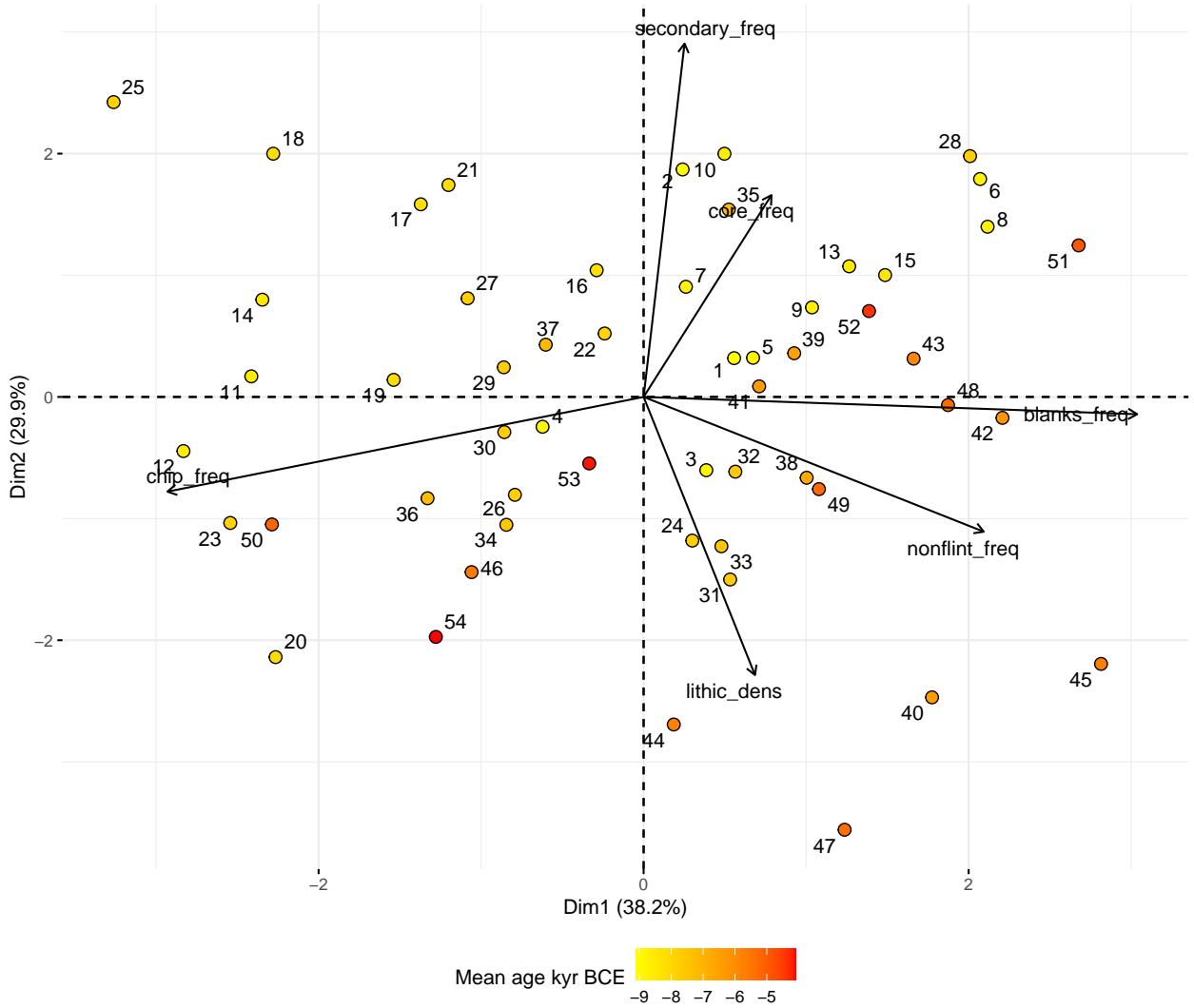


Figure 5: PCA using variables that have been related to mobility patterns. Note that details on the transformation of the variables has been left out of the plot for clarity, but follow those given in Figure 4.

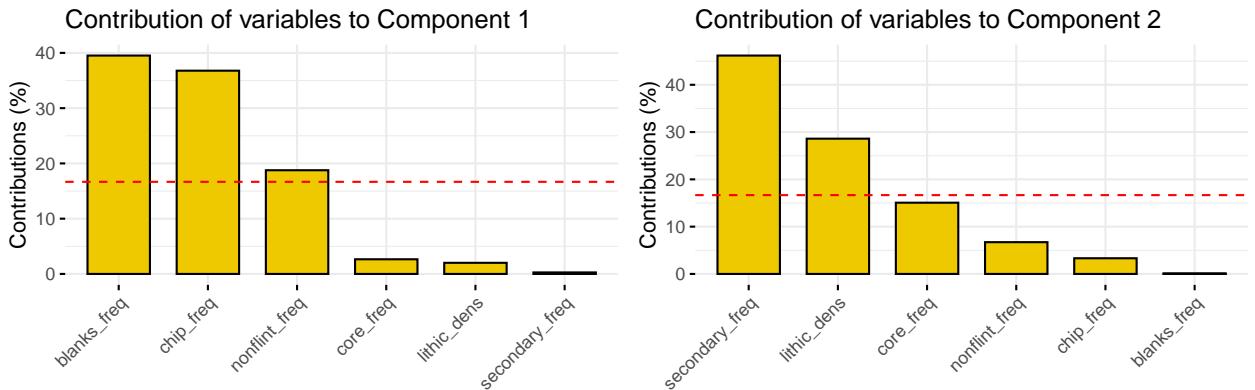


Figure 6: Contribution of variables to the components of the PCA. The dotted red line indicates the expected contribution from each variable given a uniform distribution of impact.

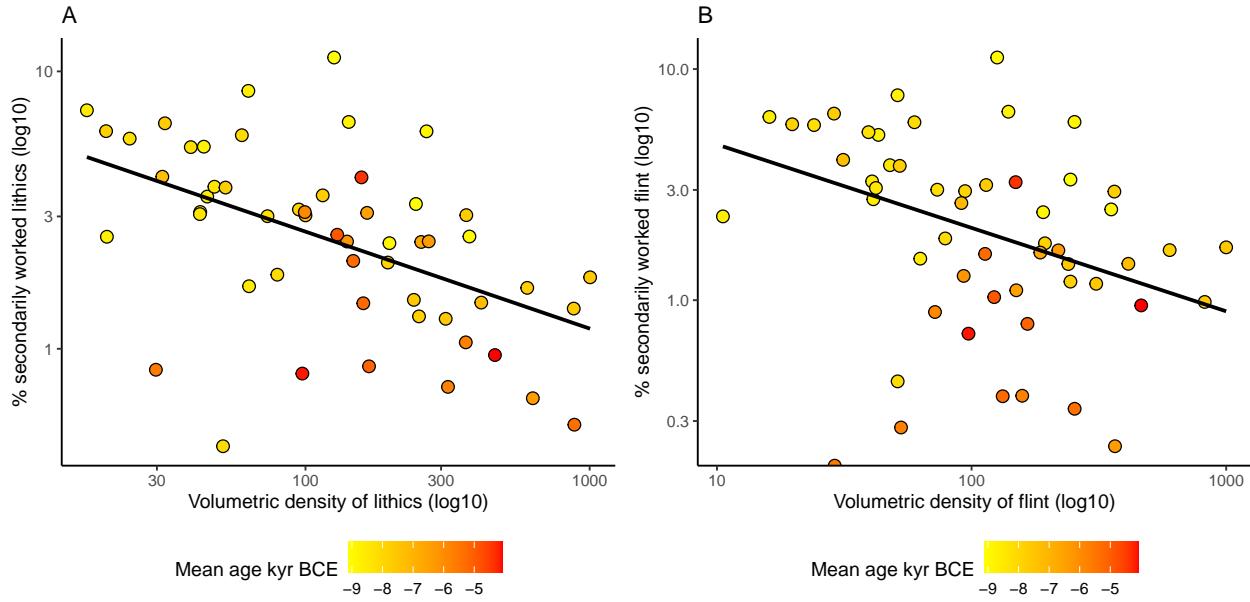


Figure 7: Relative frequency of secondarily worked lithics plotted against the volumetric density of artefacts (artefact count / excavated m<sup>3</sup>) for A) All lithics, B) Flint. The logarithm is taken to base 10 on all axes.

391 the plot, the general tendency is a relatively high degree of curation among the earlier sites, followed by a  
 392 marked drop around 8000 BCE. This has stabilised by around 7000 BCE and remains stable without any  
 393 major fluctuations for the rest of the Mesolithic. The variation in degree of curation is also markedly higher  
 394 after 8000 BCE, potentially reflecting variation in associated mobility patterns. Figure 8B displays the result  
 395 of running the same procedure on the flint data. The general pattern follows the same trajectory, but the  
 396 result for some individual sites is markedly different.

## 397 6 Discussion

398 The results of the CA does appear to align well with previous research, and the employed artefact categories  
 399 are clearly capturing a temporal component. One possible implication of this close correspondence could be  
 400 that the aggregation of artefact categories might have been overly conservative. However, it is also evidently  
 401 clear, in the words of Kruskal (1971, p. 22), that ‘time is not the only dimension.’ The results of the CA do  
 402 most certainly correspond to more pervasive cultural change than a purely typo-chronological development of  
 403 artefact morphology, which is also made evident by some of significant deviances from the overall pattern.  
 404 Unpicking and aligning these patterns with any specific behavioural and technological dimensions using the  
 405 coarse CA results is, however, another task entirely. This follows most clearly from the fact that for the  
 406 most part we do not know what individual lithic objects in the assemblages has been used for, leaving the  
 407 behavioural and social significance of the employed units of analysis unclear. The results of the CA can,  
 408 however, be used in conjunction with the part of the analysis that has attempted to get at more specific  
 409 behavioural dimensions to nuance or explain discrepancies in this data.

410 The curation index has relatively high values until some time before 8000 BCE, before it drops and stabilises  
 411 around 7000 BCE for the rest of the Mesolithic. This pattern is evident in both the flint data and when all  
 412 lithics are treated in aggregate. Furthermore, the variation in degree of curation in Figure 8A could indicate  
 413 that the sites were associated with a more varied mobility pattern after around 8000 BCE. The five sites that  
 414 have values on the curation index below c. -0.25 could in this perspective have predominantly functioned as  
 415 base camps within a logistic settlement pattern (*sensu* Binford, 1980). That these assemblages reflect stays  
 416 of a longer duration was suggested for all five sites in the original reports (Carrasco et al., 2014; Eigeland  
 417 and Fossum, 2017; Persson, 2014; Solheim and Olsen, 2013), with the exception of for Vallermyrene 4, which

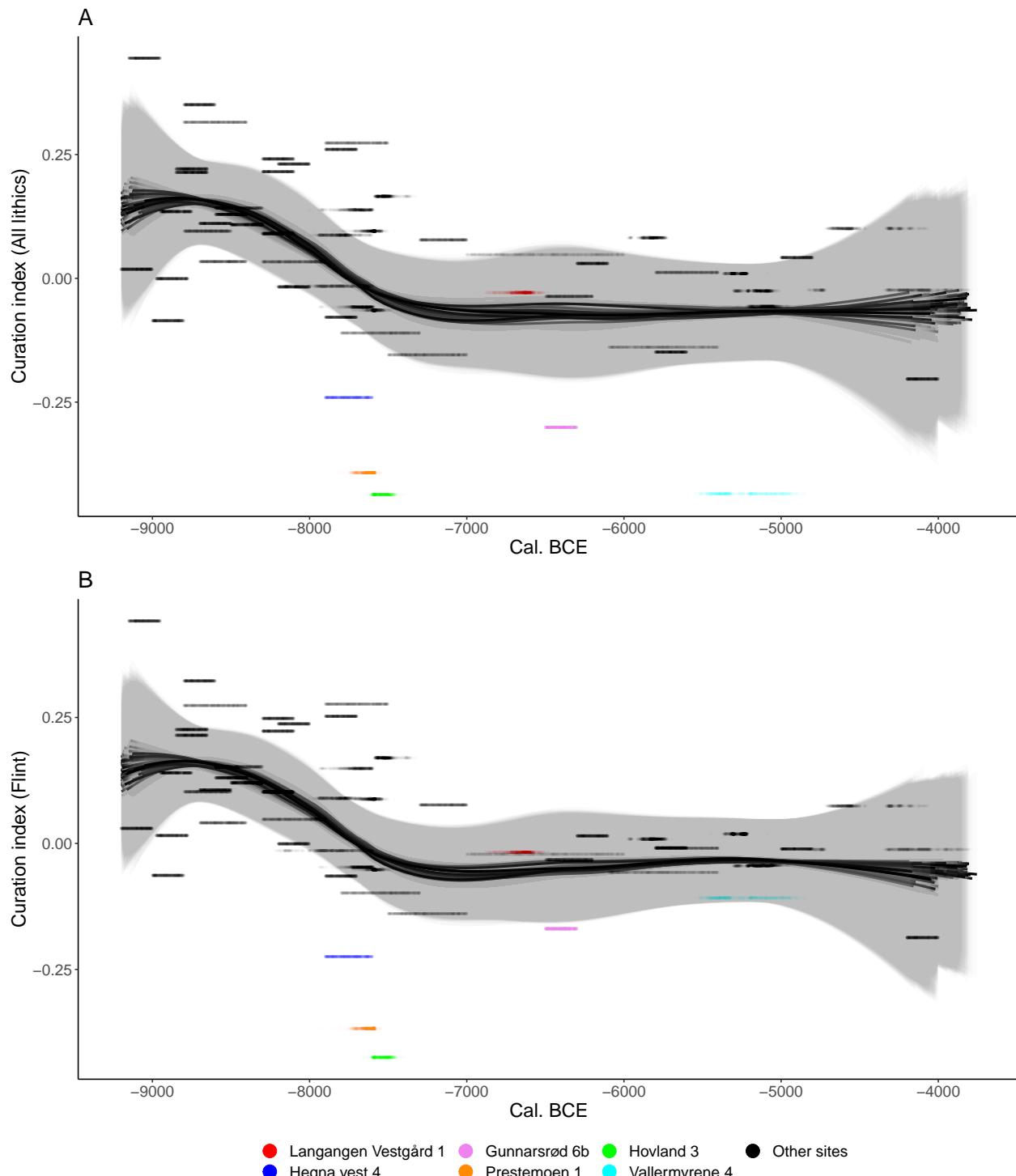


Figure 8: Temporal variation in the curation index for A) All lithics, and B) Flint. The temporal uncertainty is handled by means of a simulation approach where the site ages are drawn from their respective age determination probability density functions given in Figure 1B. A LOESS curve has been fit to the distribution for each of the 1000 simulation runs. Each simulation run is plotted with some transparency. Sites mentioned in the text are given colour.

418 was argued to be a specialised axe production site, not necessarily associated with lower degrees of mobility  
419 (Eigeland and Fossum, 2014). This highlights a possible issue pertaining to raw-material variability, as the  
420 coarse non-flint material used for the production of axes generally results in a relatively large amount of  
421 waste per produced tool, possibly skewing the curation index when compared to assemblages dominated by  
422 flint. Referring back to the CA, the difference is most marked for the sites in the later part of the Mesolithic  
423 where non-flint material become more dominating parts of the assemblages. As can be seen in Figure 8B,  
424 the degree of curation is markedly higher for both Gunnarsrød 6b and Vallermyrene 4 when the non-flint  
425 material is excluded, although they remain more expedient than that of contemporary assemblages. Thus, the  
426 degree of expediency for assemblages dominated by non-flint materials might be somewhat exaggerated when  
427 the non-flint material is included, while its exclusion would likely lead to its underestimation. One possible  
428 approach could be to weigh the curation index by proportion of non-flint material in the assemblages. This  
429 is not explored further here, however, as the overall tendencies are relatively robust to this effect. Another  
430 case also worth commenting on is Langangen Vestgård 1, which, on the grounds of an overall large number  
431 of artefacts and the possible presence of a dwelling structure was argued to reflect a more permanent site  
432 location in the original report (Melvold and Eigeland, 2014). However, the relatively high value on the  
433 curation index could mean that Langangen Vestgård 1 reflects the aggregation of stays which predominantly  
434 have been of a comparable duration to those on contemporary sites, while the possible dwelling structure, if  
435 taken as an indication of longer stays, could in this perspective represent a remnant from one or a few visits  
436 of longer duration that constitute a smaller fraction of the use-life of the site as a whole (cf. Barton and  
437 Riel-Salvatore, 2014).

438 While there are certainly nuances in the material that might lead one to question the applicability of the VDL  
439 and RFSL measures for any individual site, the overall pattern for curation does appear relatively robust.  
440 The curation index is relatively high and uniform until some time before 8000 BCE. This corresponds well  
441 with the view that the Early Mesolithic is characterised by a relatively high and uniform degree of mobility  
442 (e.g. Bjerck, 2008; Breivik and Callanan, 2016; Fuglestvedt, 2012). This is followed by a marked increase  
443 in expediency, which has stabilised by around 7000 BCE. Again, this corresponds well with the employed  
444 chronological framework. Referring back to the demographic changes that are to take place around this  
445 transition, the Microlith phase could thus represent a period where migrating people and new living practices  
446 were propagating through societies in south-eastern Norway—a process that in light of the curation data  
447 would have concluded around 7000 BCE.

448 The curation index then remains stable for the rest of the Mesolithic. This suggests that the transition to  
449 mobility patterns traditionally ascribed to the Nøstvet Phase can indeed be traced back to the Microlith  
450 Phase (Solheim and Persson, 2016). The continued stability of the curation index could also indicate that the  
451 demographic changes suggested to take place in the Transverse Arrowhead Phase are not related to major  
452 shifts in land-use and mobility patterns in the material treated here. However, it is worth highlighting the  
453 strained sample size for the later parts of the Mesolithic, which could mean that the effect is simply missed,  
454 especially if the signal is weaker than that for the transition from the Early Mesolithic.

455 As it stands, the main hypotheses resulting from the present analysis would be that settlement patterns in  
456 the earliest parts of the Mesolithic were characterised by relatively high and uniform degrees of mobility,  
457 which then drop before levelling off at around 7000 BCE. These then remain relatively stable throughout the  
458 rest of the period, despite variation pertaining to other aspects of the lithic inventories, as evidenced by the  
459 CA. Although the precise nature of this transition would require further consideration, the quite dramatic  
460 fall in curation levels and parallel increase in variation would seem to correlate well with a transition from a  
461 predominantly residential to logistical settlement system (Barton et al., 2011; Binford, 1980).

## 462 7 Conclusion

463 The results of the CA align fairly well with results of previous research in south-eastern Norway. This  
464 would indicate that in general, meaningful chronological patterning is associated with the employed artefact  
465 categories. These tendencies are already well-established when it comes to the formal tool types and some  
466 debitage categories, but have been given less focus in light of entire assemblages. Precisely what behavioural

467 implication the development in the occurrences of the tool and debitage categories have are less clear, but  
468 appears to follow a different and more complex development over time than that of curation, as operationalised  
469 here.

470 The temporal trends associated with the curation index corresponds surprisingly well with trajectories of  
471 cultural development previously suggested in the literature, and does therefore, in my view, suggest that  
472 shifts in land-use and mobility patterns are the main drivers behind this empirical pattern — in line with  
473 the framework of Barton et al. (2011). Another perspective would be that this is not surprising at all (cf.  
474 Kuhn and Clark, 2015, p. 14), and that the previously demonstrated relevance of these measures across  
475 a wide range of contexts points to their pervasive relevance for the organisation of lithic technology, and,  
476 therefore, that there should be little reason to think Mesolithic south-eastern Norway should be any different.  
477 However, the conclusion that these these measures apply to and appear to capture the dimensions of interest  
478 in a controlled empirical setting, reached by means of an exploratory analysis can only constitute a first  
479 analytical step. As Elster (2015, p. 12) has pointed out, the human mind seems to have a propensity to settle  
480 for an explanation that *can* be true, as soon as this has been reached. This, however, can only constitute the  
481 absolute minimum of what is required of a proposed explanation. Subsequent steps should be to probe and  
482 challenge this explanatory framework, also in light of alternative hypotheses. The empirical relationship does  
483 nonetheless hold great potential for large scale comparative studies in Mesolithic Scandinavia and beyond.  
484 Furthermore, the temporal trends associated with the curation index was here simply narratively associated  
485 with the most immediate chronological trends emphasised in the literature concerned with the Mesolithic  
486 of south-eastern Norway. The explicit quantification does, however, offer the possibility to conduct formal  
487 comparisons with a wide range of environmental, demographic and cultural dimensions across multiple scales  
488 of analysis.

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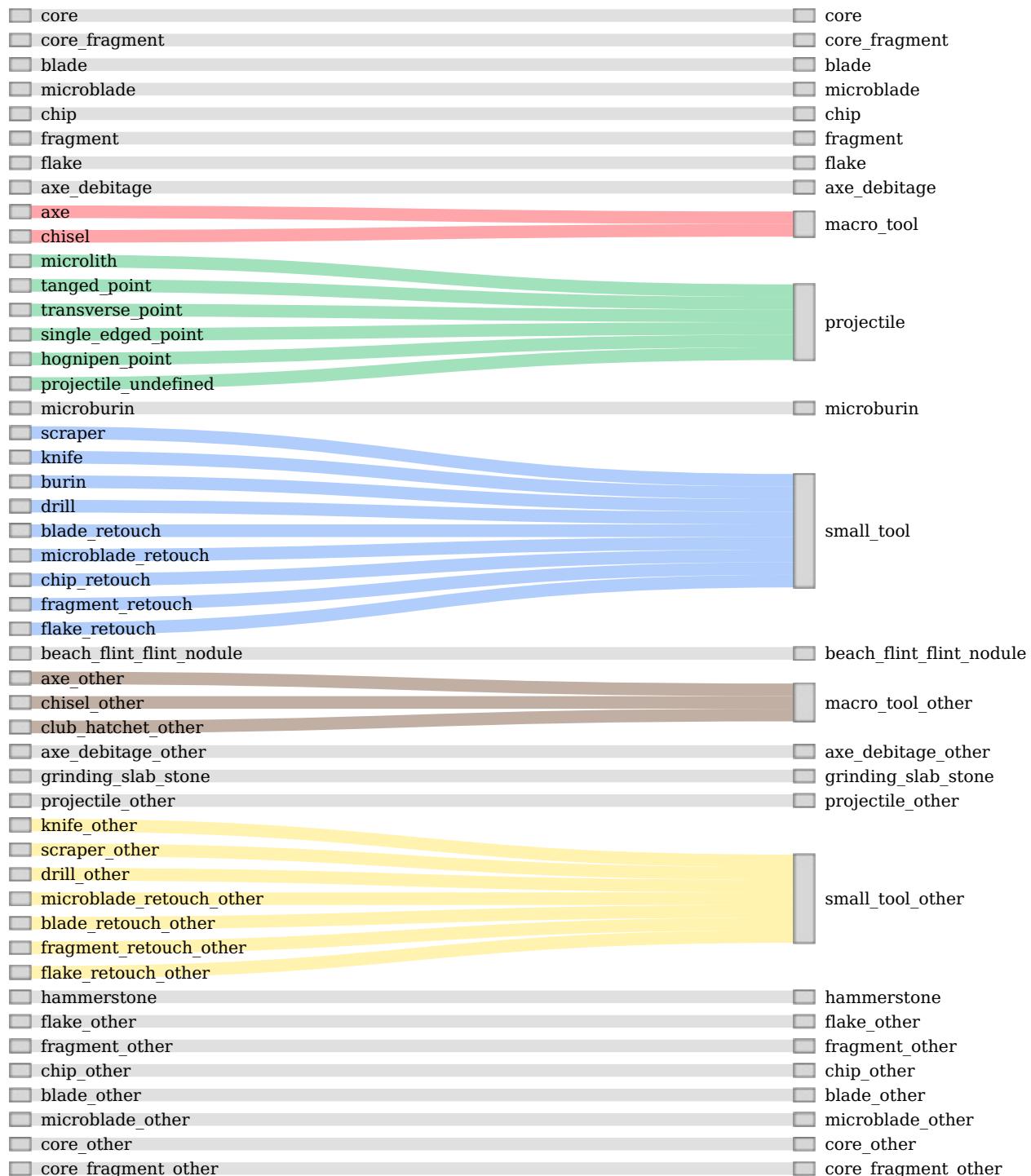
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<sup>762</sup> 9 Supplementary material A. Radiocarbon dates.

Site name	Material	Lab code	C14-age	Error
Hovland 5	Hazel ( <i>Corylus</i> ), nutshell	Ua-45490	8775	52
Hovland 4	Burnt bone	Ua-45500	8747	64
Hovland 4	Hazel ( <i>Corylus</i> ), nutshell	Ua-45499	8630	49
Hovland 4	Birch ( <i>Betula</i> )	Ua-45493	8568	51
Hovland 4	Birch ( <i>Betula</i> )	Ua-45494	8526	52
Hovland 1	Hazel ( <i>Corylus</i> )	TRa-3410	8465	55
Hovland 1	Aspen/willow ( <i>Populus/Salix</i> )	Ua-45675	8623	50
Hovland 1	Birch ( <i>Betula</i> ), resin	AAR-16884	8582	33
Hovland 3	Birch ( <i>Betula</i> )	Ua-45507	8609	54
Hovland 3	Hazel ( <i>Corylus</i> ), nutshell	Ua-45515	8606	50
Hovland 3	Birch ( <i>Betula</i> )	Ua-45509	8594	48
Hovland 3	Rowan ( <i>Sorbus</i> )	Ua-45508	8591	50
Hovland 3	Birch ( <i>Betula</i> )	Ua-45504	8584	49
Hovland 3	Rowan ( <i>Sorbus</i> )	Ua-45514	8552	50
Hovland 3	Hazel ( <i>Corylus</i> ), nutshell	Ua-45517	8540	51
Hovland 3	Rowan ( <i>Sorbus</i> )	Ua-45505	8467	53
Hovland 3	Birch ( <i>Betula</i> )	Ua-45511	8465	48
Hovland 3	Rowan ( <i>Sorbus</i> )	Ua-45506	8458	48
Hovland 3	Hazel ( <i>Corylus</i> ), nutshell	Beta-325802	8450	40
Hovland 3	Hazel ( <i>Corylus</i> ), nutshell	Ua-45516	8428	50
Hovland 3	Hazel ( <i>Corylus</i> ), nutshell	Ua-45522	8398	49
Hovland 3	Hazel ( <i>Corylus</i> ), nutshell	Ua-45520	8387	47
Hovland 3	Hazel ( <i>Corylus</i> ), nutshell	Ua-45519	8383	47
Hovland 3	Birch ( <i>Betula</i> )	Ua-45503	8376	51
Hovland 3	Birch ( <i>Betula</i> )	Ua-45512	8348	47
Hovland 3	Hazel ( <i>Corylus</i> ), nutshell	Ua-45518	8291	48
Torstvet	Hazel ( <i>Corylus</i> ), nutshell	TRa-3406	8460	55
Torstvet	Hazel ( <i>Corylus</i> ), nutshell	TRa-3407	8425	55
Prestemoen 1	Hazel ( <i>Corylus</i> ), nutshell	Ua-45176	8671	45
Prestemoen 1	Burnt bone	Ua-45177	8620	45
Prestemoen 1	Hazel ( <i>Corylus</i> ), nutshell	Ua-45178	8593	46
Langangen Vestgård 1	Burnt bone	TRa-1994	7785	40
Langangen Vestgård 1	Burnt bone	TRa-1995	7760	40
Langangen Vestgård 1	Pine ( <i>Pinus</i> )	TRa-2243	7780	70
Langangen Vestgård 1	Birch/rowan ( <i>Betula/Sorbus</i> )	TRa-4114	7870	45
Langangen Vestgård 1	Hazel ( <i>Corylus</i> )	TRa-4115	7740	45
Langangen Vestgård 1	Hazel ( <i>Corylus</i> )	TRa-4116	7800	45
Langangen Vestgård 1	Pine ( <i>Pinus</i> )	TRa-4117	8030	55
Langangen Vestgård 1	Willow ( <i>Salix</i> )	TRa-4118	8005	45
Langangen Vestgård 1	Birch/hazel ( <i>Betula/Corylus</i> )	TRa-4119	7850	45
Langangen Vestgård 1	Hazel ( <i>Corylus</i> )	TRa-4120	7875	45
Langangen Vestgård 1	Birch/willow ( <i>Betula/Salix</i> )	TRa-4121	7945	45
Langangen Vestgård 1	Burnt bone	TRa-4122	7795	40
Langangen Vestgård 1	Burnt bone	TRa-4123	7745	35
Vallermyrene 4	Burnt bone	Ua-45169	6489	50
Vallermyrene 4	Burnt bone	Ua-45170	6381	37
Vallermyrene 4	Pine ( <i>Pinus</i> )	Ua-45172	6197	40
Vallermyrene 4	Pine ( <i>Pinus</i> )	Ua-45171	6067	41
Vallermyrene 1	Pine ( <i>Pinus</i> )	Ua-45182	5770	35
Vallermyrene 1	Pine ( <i>Pinus</i> )	Ua-45181	5748	35

Vallermyrene 1	Birch (Betula)	Ua-45180	5373	34
Langangen Vestgård 3	Pine (Pinus)	TRa-2246	5400	55
Langangen Vestgård 3	Pine (Pinus)	TRa-2247	5325	50
Langangen Vestgård 3	Pine (Pinus)	TRa-2248	5910	10
Langangen Vestgård 3	Pine (Pinus)	TRa-4126	5095	40
Langangen Vestgård 3	Birch (Betula)	TRa-2249	5325	45
Langangen Vestgård 3	Birch (Betula)	TRa-2250	5325	50
Gunnarsrød 4	Birch (Betula)	UBA-19159	6941	36
Hegna vest 2	Pine (Pinus)	Ua-50497	8708	38
Hegna vest 1	Aspen/willow (Populus/Salix)	Ua-50485	8788	34
Hegna vest 1	Willow (Salix)	Ua-51462	8732	40
Hegna vest 3	Aspen/willow (Populus/Salix)	Ua-51471	8679	39
Stokke/Polland 8	Birch (Betula)	Ua-51840	6215	35
Hegna øst 2	Pine (Pinus)	Ua-50501	6318	26
Stokke/Polland 5	Pomoideae (Malinae)	Ua-48257	6098	40
Stokke/Polland 5	Hazel (Corylus)	Ua-48258	6177	42
Stokke/Polland 5	Alder (Alnus)	Ua-50501	6196	40

763 10 Supplementary material B. Aggregation of variables for the  
 764 correspondence analysis.



765

766 10.0.1 Colophon

767 This report was generated on 2021-07-26 00:00:23 using the following computational environment and  
768 dependencies:

```
769 #> - Session info -----
770 #>   setting  value
771 #>   version R version 4.1.0 (2021-05-18)
772 #>   os        Linux Mint 19.3
773 #>   system   x86_64, linux-gnu
774 #>   ui        X11
775 #>   language en_US
776 #>   collate  en_US.UTF-8
777 #>   ctype    en_US.UTF-8
778 #>   tz       Europe/Oslo
779 #>   date     2021-07-26
780 #>
781 #> - Packages -----
782 #>   package * version date      lib source
783 #>   abind     1.4-5   2016-07-21 [1] CRAN (R 4.1.0)
784 #>   assertthat 0.2.1   2019-03-21 [1] CRAN (R 4.1.0)
785 #>   backports   1.2.1   2020-12-09 [1] CRAN (R 4.1.0)
786 #>   bitops     1.0-7   2021-04-24 [1] CRAN (R 4.1.0)
787 #>   bookdown   0.22    2021-04-22 [1] CRAN (R 4.1.0)
788 #>   broom      0.7.6   2021-04-05 [1] CRAN (R 4.1.0)
789 #>   cachem     1.0.5   2021-05-15 [1] CRAN (R 4.1.0)
790 #>   callr      3.7.0   2021-04-20 [1] CRAN (R 4.1.0)
791 #>   car        3.0-10  2020-09-29 [1] CRAN (R 4.1.0)
792 #>   carData    3.0-4   2020-05-22 [1] CRAN (R 4.1.0)
793 #>   cellranger 1.1.0   2016-07-27 [1] CRAN (R 4.1.0)
794 #>   checkmate   2.0.0   2020-02-06 [1] CRAN (R 4.1.0)
795 #>   class      7.3-19  2021-05-03 [4] CRAN (R 4.0.5)
796 #>   classInt   0.4-3   2020-04-07 [1] CRAN (R 4.1.0)
797 #>   cli         2.5.0   2021-04-26 [1] CRAN (R 4.1.0)
798 #>   cluster     2.1.2   2021-04-17 [4] CRAN (R 4.0.5)
799 #>   colorspace  2.0-1   2021-05-04 [1] CRAN (R 4.1.0)
800 #>   crayon     1.4.1   2021-02-08 [1] CRAN (R 4.1.0)
801 #>   curl        4.3.1   2021-04-30 [1] CRAN (R 4.1.0)
802 #>   data.table  1.14.0  2021-02-21 [1] CRAN (R 4.1.0)
803 #>   DBI         1.1.1   2021-01-15 [1] CRAN (R 4.1.0)
804 #>   dbplyr     2.1.1   2021-04-06 [1] CRAN (R 4.1.0)
805 #>   desc        1.3.0   2021-03-05 [1] CRAN (R 4.1.0)
806 #>   devtools    2.4.2   2021-06-07 [1] CRAN (R 4.1.0)
807 #>   digest     0.6.27  2020-10-24 [1] CRAN (R 4.1.0)
808 #>   dplyr      * 1.0.6  2021-05-05 [1] CRAN (R 4.1.0)
809 #>   DT          0.18    2021-04-14 [1] CRAN (R 4.1.0)
810 #>   e1071      1.7-7   2021-05-23 [1] CRAN (R 4.1.0)
811 #>   ellipsis    0.3.2   2021-04-29 [1] CRAN (R 4.1.0)
812 #>   evaluate    0.14    2019-05-28 [1] CRAN (R 4.1.0)
813 #>   factoextra * 1.0.7  2020-04-01 [1] CRAN (R 4.1.0)
814 #>   FactoMineR * 2.4    2020-12-11 [1] CRAN (R 4.1.0)
815 #>   fansi        0.5.0   2021-05-25 [1] CRAN (R 4.1.0)
816 #>   farver      2.1.0   2021-02-28 [1] CRAN (R 4.1.0)
817 #>   fastmap     1.1.0   2021-01-25 [1] CRAN (R 4.1.0)
```

```

818 #> flashClust      1.01-2  2012-08-21 [1] CRAN (R 4.1.0)
819 #> forcats        * 0.5.1   2021-01-27 [1] CRAN (R 4.1.0)
820 #> foreign         0.8-81   2020-12-22 [4] CRAN (R 4.0.3)
821 #> fs              1.5.0    2020-07-31 [1] CRAN (R 4.1.0)
822 #> generics        0.1.0    2020-10-31 [1] CRAN (R 4.1.0)
823 #> GGally          * 2.1.1   2021-03-08 [1] CRAN (R 4.1.0)
824 #> ggmap           3.0.0    2019-02-05 [1] CRAN (R 4.1.0)
825 #> ggplot2         * 3.3.3   2020-12-30 [1] CRAN (R 4.1.0)
826 #> ggpubr          0.4.0    2020-06-27 [1] CRAN (R 4.1.0)
827 #> ggrepel          0.9.1    2021-01-15 [1] CRAN (R 4.1.0)
828 #> ggridges         * 0.5.3   2021-01-08 [1] CRAN (R 4.1.0)
829 #> ggsignif         0.6.1    2021-02-23 [1] CRAN (R 4.1.0)
830 #> ggsn            0.5.0    2019-02-18 [1] CRAN (R 4.1.0)
831 #> glue             1.4.2    2020-08-27 [1] CRAN (R 4.1.0)
832 #> gt              * 0.3.0   2021-05-12 [1] CRAN (R 4.1.0)
833 #> gtable           0.3.0    2019-03-25 [1] CRAN (R 4.1.0)
834 #> haven            2.4.1    2021-04-23 [1] CRAN (R 4.1.0)
835 #> here             1.0.1    2020-12-13 [1] CRAN (R 4.1.0)
836 #> highr            0.9      2021-04-16 [1] CRAN (R 4.1.0)
837 #> hms              1.1.0    2021-05-17 [1] CRAN (R 4.1.0)
838 #> htmltools         0.5.1.1  2021-01-22 [1] CRAN (R 4.1.0)
839 #> htmlwidgets       1.5.3    2020-12-10 [1] CRAN (R 4.1.0)
840 #> httr              1.4.2    2020-07-20 [1] CRAN (R 4.1.0)
841 #> igraph            1.2.6    2020-10-06 [1] CRAN (R 4.1.0)
842 #> jpeg              0.1-8.1  2019-10-24 [1] CRAN (R 4.1.0)
843 #> jsonlite          1.7.2    2020-12-09 [1] CRAN (R 4.1.0)
844 #> KernSmooth        2.23-20  2021-05-03 [4] CRAN (R 4.0.5)
845 #> knitr             1.33     2021-04-24 [1] CRAN (R 4.1.0)
846 #> labeling           0.4.2    2020-10-20 [1] CRAN (R 4.1.0)
847 #> lattice            0.20-44  2021-05-02 [4] CRAN (R 4.1.0)
848 #> leaps              3.1      2020-01-16 [1] CRAN (R 4.1.0)
849 #> lifecycle          1.0.0    2021-02-15 [1] CRAN (R 4.1.0)
850 #> lubridate          1.7.10   2021-02-26 [1] CRAN (R 4.1.0)
851 #> magrittr           2.0.1    2020-11-17 [1] CRAN (R 4.1.0)
852 #> maptools           1.1-1    2021-03-15 [1] CRAN (R 4.1.0)
853 #> MASS               7.3-54   2021-05-03 [4] CRAN (R 4.0.5)
854 #> Matrix              1.3-4    2021-06-01 [4] CRAN (R 4.1.0)
855 #> memoise            2.0.0    2021-01-26 [1] CRAN (R 4.1.0)
856 #> mgcv                1.8-36   2021-06-01 [4] CRAN (R 4.1.0)
857 #> modelr              0.1.8    2020-05-19 [1] CRAN (R 4.1.0)
858 #> munsell            0.5.0    2018-06-12 [1] CRAN (R 4.1.0)
859 #> networkD3          * 0.4     2017-03-18 [1] CRAN (R 4.1.0)
860 #> nlme                3.1-152  2021-02-04 [4] CRAN (R 4.0.3)
861 #> openxlsx            4.2.3    2020-10-27 [1] CRAN (R 4.1.0)
862 #> oxcAAR              * 1.1.0   2021-02-23 [1] CRAN (R 4.1.0)
863 #> patchwork           * 1.1.1   2020-12-17 [1] CRAN (R 4.1.0)
864 #> pillar              1.6.1    2021-05-16 [1] CRAN (R 4.1.0)
865 #> pkgbuild            1.2.0    2020-12-15 [1] CRAN (R 4.1.0)
866 #> pkgconfig            2.0.3    2019-09-22 [1] CRAN (R 4.1.0)
867 #> pkgload              1.2.1    2021-04-06 [1] CRAN (R 4.1.0)
868 #> plyr                 1.8.6    2020-03-03 [1] CRAN (R 4.1.0)
869 #> png                  0.1-7    2013-12-03 [1] CRAN (R 4.1.0)
870 #> prettyunits          1.1.1    2020-01-24 [1] CRAN (R 4.1.0)
871 #> processx            3.5.2    2021-04-30 [1] CRAN (R 4.1.0)

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872 #> proxy          0.4-25  2021-03-05 [1] CRAN (R 4.1.0)
873 #> ps              1.6.0   2021-02-28 [1] CRAN (R 4.1.0)
874 #> purrr           * 0.3.4  2020-04-17 [1] CRAN (R 4.1.0)
875 #> R6               2.5.0   2020-10-28 [1] CRAN (R 4.1.0)
876 #> RColorBrewer    1.1-2   2014-12-07 [1] CRAN (R 4.1.0)
877 #> Rcpp              1.0.6   2021-01-15 [1] CRAN (R 4.1.0)
878 #> readr             * 1.4.0  2020-10-05 [1] CRAN (R 4.1.0)
879 #> readxl            1.3.1   2019-03-13 [1] CRAN (R 4.1.0)
880 #> remotes           2.4.0   2021-06-02 [1] CRAN (R 4.1.0)
881 #> reprex             2.0.0   2021-04-02 [1] CRAN (R 4.1.0)
882 #> reshape             0.8.8  2018-10-23 [1] CRAN (R 4.1.0)
883 #> RgoogleMaps       1.4.5.3 2020-02-12 [1] CRAN (R 4.1.0)
884 #> rio                0.5.26  2021-03-01 [1] CRAN (R 4.1.0)
885 #> rjson              0.2.20  2018-06-08 [1] CRAN (R 4.1.0)
886 #> rlang              0.4.11  2021-04-30 [1] CRAN (R 4.1.0)
887 #> rmarkdown           2.9     2021-06-15 [1] CRAN (R 4.1.0)
888 #> rnaturalearth      * 0.1.0  2017-03-21 [1] CRAN (R 4.1.0)
889 #> rprojroot           2.0.2   2020-11-15 [1] CRAN (R 4.1.0)
890 #> rstatix             0.7.0   2021-02-13 [1] CRAN (R 4.1.0)
891 #> rstudioapi          0.13    2020-11-12 [1] CRAN (R 4.1.0)
892 #> rvest                1.0.0   2021-03-09 [1] CRAN (R 4.1.0)
893 #> scales              1.1.1   2020-05-11 [1] CRAN (R 4.1.0)
894 #> scatterplot3d       0.3-41  2018-03-14 [1] CRAN (R 4.1.0)
895 #> sessioninfo         1.1.1   2018-11-05 [1] CRAN (R 4.1.0)
896 #> sf                  * 0.9-8  2021-03-17 [1] CRAN (R 4.1.0)
897 #> sp                  1.4-5   2021-01-10 [1] CRAN (R 4.1.0)
898 #> stringi              1.6.2   2021-05-17 [1] CRAN (R 4.1.0)
899 #> stringr              * 1.4.0  2019-02-10 [1] CRAN (R 4.1.0)
900 #> testthat             3.0.2   2021-02-14 [1] CRAN (R 4.1.0)
901 #> tibble              * 3.1.2  2021-05-16 [1] CRAN (R 4.1.0)
902 #> tidyverse             * 1.1.3  2021-03-03 [1] CRAN (R 4.1.0)
903 #> tidyselect            1.1.1   2021-04-30 [1] CRAN (R 4.1.0)
904 #> tidyverse             * 1.3.1  2021-04-15 [1] CRAN (R 4.1.0)
905 #> units                0.7-1   2021-03-16 [1] CRAN (R 4.1.0)
906 #> usethis              2.0.1   2021-02-10 [1] CRAN (R 4.1.0)
907 #> utf8                 1.2.1   2021-03-12 [1] CRAN (R 4.1.0)
908 #> vctrs                 0.3.8   2021-04-29 [1] CRAN (R 4.1.0)
909 #> webshot              0.5.2   2019-11-22 [1] CRAN (R 4.1.0)
910 #> withr                 2.4.2   2021-04-18 [1] CRAN (R 4.1.0)
911 #> xfun                  0.24    2021-06-15 [1] CRAN (R 4.1.0)
912 #> xml2                  1.3.2   2020-04-23 [1] CRAN (R 4.1.0)
913 #> yaml                  2.2.1   2020-02-01 [1] CRAN (R 4.1.0)
914 #> zip                  2.2.0   2021-05-31 [1] CRAN (R 4.1.0)
915 #>
916 #> [1] /home/isak/R/x86_64-pc-linux-gnu-library/4.1
917 #> [2] /usr/local/lib/R/site-library
918 #> [3] /usr/lib/R/site-library
919 #> [4] /usr/lib/R/library

```

920 The current Git commit details are:

```

921 #> Local:    master /home/isak/phd/meso_assemblages/exploring-assemblages-se-norway
922 #> Remote:   master @ origin (https://github.com/isakro/dialpastrepository.git)
923 #> Head:     [972d781] 2021-07-25: Reworking structure and attempting to number sites in overview map

```