[Supplementary material]

First encounters in the north: cultural diversity and gene flow in Early Mesolithic Scandinavia

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All radiocarbon dates in the OSM, as well as in the main article, are calibrated with the IntCal 13 calibration curve, either with the OxCal program (Bronk Ramsey 2009) or the rcarbon program (Bevan & Crema 2018). There are only very minor differences between the results from these two programmes.

Background

There is substantial archaeological evidence of a dual-route colonisation of the Scandinavian Peninsula at the end of the last Ice Age: one route from the south, and a second from the northeast. Differences between the pioneer colonizers that utilized these routes are manifested in material culture (e.g. Sørensen *et al.* 2013; Damlien 2016a; Knutsson *et al.* 2016; Manninen *et al.* 2018). In Scandinavia, the southern Early Mesolithic (*c*. 9500–8300 BC) lithic blade technology traditionally associated with the Fosna (Phase 1) and Hensbacka find groups, is characterised by blade detachment from one-sided cores with one or two opposed platforms by direct percussion techniques. Diagnostic tools include small tanged points of Ahrensburgian type, single-edged points, and geometric microliths as well as flake and core

axes. For these (so-called) western groups a clear affinity with the Upper Palaeolithic Ahrensburgian of the West European Plain both in terms of lithic technology and tool morphology seems clear (e.g. Fischer 1996; Kindgren 1996a; Bjerck 2008; Schmitt *et al.* 2009; Bang-Andersen 2012; Fuglestvedt 2012; Berg-Hansen 2017, 2018).

The north-eastern route is, on the other hand, associated with the spread of the pressure blade technology, known in preceding centuries from the East European Plain and areas further east. The pressure blade technology involved blade production from conical and sub-conical cores with faceted platforms by means of pressure and indirect percussion techniques (Rankama & Kankaanpää 2011; Sørensen *et al.* 2013; Damlien 2016a; Knutsson *et al.* 2016; Manninen *et al.* 2018). The pressure blade technology was part of the so-called eastern technological package which also seems to have included concepts for crafting composite bone tools (Bergsvik & David 2015; Knutsson *et al.* 2016; David & Kjällquist 2018) and ground macro tools (see e.g. Hartz *et al.* 2010; Anttiroiko 2015).

Because of constraints set by the physical environment, the most likely scenario concerning the earliest human colonisation of the Scandinavian Peninsula, is that the area of present-day Norway was first colonised from the south, through west Sweden, by people following the ice-free coastline all the way to the northernmost parts of Fennoscandia. Excluding the Atlantic coastal strip, the Scandinavian Peninsula was covered by the Scandinavian Ice Sheet during the first postglacial human dispersal, while the ice covering the Oslofjord area closed the coastal passage to the north until around 9500 BC (e.g. Bjerck 2008; Blankholm 2004, 2018; Bang-Andersen 2012; Glørstad 2016; Berg-Hansen 2018; Damlien & Solheim 2018).

The possibility of an early migration from the east into northern Norway was discussed by some researchers early on, and it was never completely abandoned (see e.g. Hagen 1967; Møller 1996). However, unambiguous archaeological evidence for an early migration to northernmost Scandinavia was lacking until excavations at the Sujala site in northernmost Finland in 2004–2006 and the recognition that the Sujala assemblage, as well as finds from nearby sites on the Norwegian side of the border, bore typological and technological traits typical of Early Mesolithic eastern pressure blade technology known from the East European Plain (Rankama & Kankaanpää 2008, 2011). This discovery was developed further in a study of the spread of pressure blade technology in Scandinavia (Sørensen *et al.* 2013) which suggested an early spread of eastern technology into Scandinavia. The hypothesis presented by Sørensen and colleges (2013), concerning the spread of the technology in Scandinavia, states that it was introduced by migrating hunter-gatherer groups reaching northernmost Finland and Norway in the late Preboreal, encountering marine oriented groups already

settled there. However, according to Sørensen *et al.* (2013: 26–27), the continuation of the western microlith armature tradition, and a slowing down of the spread of the eastern technology towards the south, suggests that it was knowledge rather than people that spread into central and western Scandinavia during the late Preboreal (Sørensen *et al*. 2013: 18). This two-route scenario is in accordance with recent aDNA studies, which show that Mesolithic Scandinavian hunter-gatherers (SHG) have genetic traces from both eastern and western groups in different proportions (Günther *et al*. 2018; Kashuba *et al.* 2019). Currently the earliest human DNA deriving from the Scandinavian peninsula is radiocarbon dated to 7930–7610 cal BC (Huseby Klev: Kashuba *et al.* 2019), while the earliest archaeological signs of human activity in southern Sweden are dated to *c*. 11 300–10 000 cal BC (Hässelberga: Magnell *et al.* 1999) and 9500 cal BC in northernmost Norway (Lagesiid'bakti 1: Grydeland 2005: 43).

Here we present the available archaeological data representing the roughly 3000 years before the earliest human DNA from Scandinavia.

Northernmost Fennoscandia

On the Russian side of the Barents Sea coast, the Gusiny site cluster on the northern shore of the Kola Peninsula has yielded assemblages representing both the western and eastern technological concepts (Murashkin & Kolpakov 2019). We dated a series of charcoal samples from these sites for this study. Gusiny 4, area 1, a site dated to *c*. 8300 cal BC by two dates on charcoal (median value of LuS-13235 and LuS-13236 combined with the R-Combine command in OxCal), yielded 52 lithic artifacts of which 16 are blades and blade fragments diagnostic of the eastern pressure blade technology, while 30 are flakes and six are small chips. Gusiny 7, a site that yielded 248 lithic artefacts in excavations, including pressure blades and related eastern artefact types, gave also Mesolithic dates, 8250 cal BC and 7870 cal BC (median values of LuS-13240 and LuS-13241 on charcoal), of which the earlier corresponds to the Gusiny 4 dates. However, at the nearby Gusiny 6 site a shallow house-pit (house 8) yielded an assemblage including a series of flake axes and single-edged points, typical of the western/Phase 1 production concept. The radiocarbon date 8230 cal BC on charcoal (LuS-13242, median value), that is associated with the lithic finds, suggests that these finds are roughly contemporaneous with the eastern blade assemblages found nearby at Gusiny 4 and 7. This shows that the western and eastern technological traditions were both present in the area.

The most thoroughly published evidence of eastern pressure blade technology in the area derives from the aforementioned Sujala site, located in northernmost Finnish Lapland. During its period of use, the site was located on a narrow island in the Lake Vetsijärvi. Excavations at the site yielded a large assemblage consisting of exhausted sub-conical blade cores with faceted platforms, pressure blades, ventrally surface retouched tanged points, core tablets, and other artefact types that are typical of the eastern production concept (Rankama & Kankaanpää 2008, 2011). There are two slightly deviating sets of radiocarbon dates from the site, 8550–8310 cal BC (charcoal) and 8280–7880 cal BC (burnt bone).

The discovery of Sujala and the identification of an early eastern technology in northernmost Lapland (Rankama & Kankaanpää 2008, 2011) was soon followed by the identification of technological features and material mirroring Sujala at several sites along the shores of the Varanger peninsula, northeast in Norway. Further, recent reviews and analyses have shown that eastern technology appears on sites along the North-Norwegian Atlantic coast, covering an area stretching from Varanger to central Nordland.

The earliest evidence of the eastern blade production concept in northern Norway is at the moment found in the Varangerfjord area in eastern Finnmark. Blades and core tablets representing the eastern pressure blade technology were found in Løkvika, a site located at the northern coast of the Varanger peninsula. The Løkvika blade assemblage is associated with two small hearths, from which charred bone material is dated to 9600–8800 cal BC (Kleppe 2014). All cores are single platform and one can be described as conical. There are no bipolar, discoid or round cores, all of which would have been typical of a Phase I "western" site. Half of the cores are red quarzitic sandstone, the rest are quartz. No cores in other raw materials have been found in spite of the clear evidence of core rejuvenation in the form of core tablets, edge removals and base removals. In total 15 raw material variants were in use at Løkvika. Red quartzitic sandstone is dominant, with quartz in second place, followed by weakly metamorphosed sandstone. Blades, blade fragments and related debitage making up 30.6 per cent of all finds, the rest of the assemblage consisting of flakes, primarily quartz, and debris. A method of production with initial soft hammer reduction producing broader blades and further reduction by pressure and/or punch producing narrower blades is evident. Broad proximal fragments display a varying degree of platform preparation, greatest care having been taken to prepare the platform on red quarzitic sandstone blades. Careful platform preparation is visible for all narrow blades regardless of raw material. Proximal fragments have lipping – broad proximal fragments less often than narrow, with a weakly displayed bulb of percussion.

The largest variation in width, thickness and butt thickness is evident in red quarzitic sandstone fragments, weakly metamorphosed sandstone specimens are generally more uniform. Thicker butts observed on some red quarzitic sandstone blades are likely a consequence of harder raw material. Breaks in general indicate snapping at right angles, with possible preparation only on some weakly metamorphosed sandstone fragments. There are breaks *en languette* on both red quarzitic sandstone and weakly metamorphosed sandstone proximal blade fragments, as seen in the Fállegoahtesajeguolbba assemblage and Sujala (Rankama and Kankaanpää 2011). For the Fállegoahtesajeguolbba site, also with eastern blade technology, located at the southern shore of the Varangerfjord, a date somewhere between 9400 and 8500 BC has been suggested using shore displacement dating and comparisons with other dates and elevations in the Varangerfjord area (Rankama & Kankaanpää 2011; Kankaanpää & Rankama 2012b; Kleppe 2014).

In the inner parts of the fjord, Sæleneshøgda, excavated in 1953 (Simonsen 1961), has played a key role in the development of the chronological framework of the Stone Age in northern Norway (Simonsen 1961; Woodman 1992; Olsen 1994). The elevation 53 masl gives a shore displacement date of 8600–7800 cal BC for the site (Anttiroiko 2015: 9, with references). The name of the site was for long an eponym for the Middle Mesolithic in the area (Phase II, *c*. 8300–6300 BC), and its western cultural affiliation was until recently not questioned. A re-examination of the material has, however, identified both the eastern and western/Phase 1 blade technologies and associated artefact types in the assemblage (Anttiroiko 2015). An additional analysis of macro tool technology by Rosenvinge documents the presence of diagnostic side edge flakes associated with flake axe production belonging to the western/Phase 1 tradition, as well as a ground axe and fragments of at least one additional ground macro tool, i.e., eastern macro tool technology. The site contains three pit huts as well as a refuse area. The artefacts related to the eastern blade production concept were mostly found in the dwelling structures.

At Stahrenjunni, 450m southeast of Sæleneshøgda, a cluster of four Mesolithic house pits and a refuse pit were investigated in 1983 (Engelstad 1989). The house pits, located on a sloping terrace, 43m asl, had the form of rounded rectangular depressions surrounded by low wall mounds, *c*. 12–15 m^2 in size. Charcoal obtained from the refuse pit was dated to 7790–5660 cal BC (T-5428: 7710±480 BP) (Engelstad 1989). Additional material was dated by Niemi in 2008. A second sample from the pit was dated to 7660–7540 cal BC (TRa-1043: 8575±40 BP), overlapping the earlier end of the old charcoal date range. Two samples from a charcoal layer in the wall mound of House E was dated to 8230–7840 cal BC (TR-a 1045: 8880±45

BP) and 7590–7490 cal BC (TR-a1042: 8475±45 BP). Blade morphology, core tablets, and conical core fragments are clear evidence of the eastern technology (Kankaanpää & Rankama 2012a, 2012b). However, the assemblage also includes quartz flakes, a few microliths, small chert nodules and bipolar cores, as well as three flake axes, which better fit with the western/Phase 1 lithic technological tradition. One of the flake axes deserve particular attention, as it was made on a fragment of a ground hollow edged gouge. The flake axe was made by removing perpendicular flakes on the working edge of what originally was a relatively large ground hollow edge macro tool. Secondarily the flake tool blank was reshaped by removing side edge flakes along the sides of the flake, keeping a portion of the ground hollow working edge intact.

On the northern shore of Varangerfjord, Mortensnes R10 is a group of eight house pits located on raised beach terraces, 37–40m asl. House pit F2 and F8 have been excavated (Schanche 1988). Both were *c*. 12m^2, with lithics concentrated to the floor areas. F2 was demarcated as a slight depression surrounded by low wall mounds which were covered by flat slabs. A central concentration of charcoal provided a date to 7910–7190 cal BC (T-6415: 8500±120 BP). F8 was situated a few metres below. The floor area was cleared of smaller stones, and its perimeter partly demarcated by larger stones. Sandy gravel mixed with charcoal in the centre of the dwelling may represent a non-lined fireplace. F8 is not radiocarbon dated. Based on the difference in elevation, F8 could be dated slightly later than F2. Recent re-examination of the material from both F2 and F8 has revealed the presence of core tablets and blades, suggesting pressure technique from conical cores (Kankaanpää & Rankama 2012a). However, the assemblage also contains a microlith, a unifacial core and irregular blades, all traits of the western/Phase 1 lithic tradition.

The earliest sites in the north-western region exhibiting eastern blade technology are found on Slettnes at the island of Sørøya in western Finnmark. At Slettnes VC conical cores and pressure-produced blades were found in beach gravel deposited during the Tapes transgression (Hesjedal *et al.* 1996: 134). No structures related to the Mesolithic occupation were preserved, and the nature and extent of the site remains unclear. Sea level displacement curves indicate that the site was first inhabitable from around 8500 cal BC (Romundset *et al.* 2011). The site is located on a gentle slope, and was probably placed at least 2–3m above the contemporary shore. This gives a date of 8300–8200 cal BC. The relative sea level low stand was around 7–8m before the rising sea soon after 8000 cal BC again submerged the site.

Of a somewhat later date is the nearby Slettnes IVA. A small dwelling unit, F45, was visible as a more or less circular shallow depression 2.6 × 2.0m in size and cleared of larger stones

(Hesjedal *et al.* 1996: 61). A charcoal concentration within the depression was interpreted as a hearth. Samples from the top and bottom of the concentration are radiocarbon dated to 7850–7360 cal BC (top layer, Beta-49008: 8550±100 BP) and 8280–7713 cal BC (bottom layer, Beta-49007: 8800±100 BP). The delimited distribution and scale of the lithic assemblage, as well as an absence of overlapping structures, indicates that Mesolithic material represents a relatively short occupation event. A date within the overlapping range of the radiocarbon dates, around 7700 cal BC, is plausible. The lithic assemblage numbered 164 items. Four slate tools point to a later occupation phase, but the remaining artefacts are strongly indicative of pressure blade production. The material includes 37 blades, three platform preparation flakes, one core tablet, as well as one possible fragment of a conical core. Apart from blade production, a small number of bipolar and irregular cores show the practicing of other production methods as well.

So far, the most comprehensive documentation of the eastern blade technology in the northwest derives from two sites in the Kvænangen, some 90km south of Slettnes. Tømmerbukt and Kviteberg, excavated in 2007–2009 (Damm & Niemi 2009; Niemi 2010), yielded a very rich blade material which presented an opportunity to carry out detailed technological analyses (A.R. Niemi *pers. comm.*).

Kviteberg is located *c.* 30m asl, on sloping ancient marine gravel terraces covered by a thin layer of turf, facing the fjord in the west. At the time of occupation, this was the head of a small sheltered bay at the western side of an isthmus. An area of 173m^2 was excavated, covering two dwelling structures in the shape of shallow circular depressions, and an extensive activity area. No organic material was preserved, and charcoal was only present in the dwelling structure situated slightly below the activity area (House 3). Bordering to the northeastern bank of this relatively small (3m in diameter) structure, a depression containing fire-cracked rocks, soot and yellow gravel was found. Charcoal from *salix* from the bottom of this depression was dated to 7460–7070 cal BC (Wk-23669: 8226±60 BP) and 7480–7190 cal BC (TRa-2769: 8295±50 BP). The 656 items from House 3 cover flakes and bipolar cores of beach flint and jasper, but also some chert, quartz and quartzite. Most noteworthy, there was no clear evidence of blade technology in the inventory from this dwelling. The radiocarbon date can, however, be applied to two bifacially worked broken macro tool preforms, most probably representing preforms for ground macro tools.

The activity area just above House 3 and the higher lying dwelling, House 2, yielded a very rich blade material and one complete bifacially worked preform. Before the excavation started, House 2 was visible as a shallow depression. After removal of the turf, it pertained

that a 2.0 × 2.5m wide area had been cleared of larger stones, but that no soil had been removed from the centre of this area. There was no indication of a fireplace. The activity area just below House 2 contained no obvious structures. More or less circular concentrations of lithic material and more scattered accumulations of fire-cracked rocks might indicate the presence of lighter habitation structures like tents or lean-tos. Analyses of the material have revealed no significant variations between House 2 and the activity area. Hence, it is assumed that they originate from the same or closely related occupation episodes. Based on the extensive and intensive activity, the presence of dwelling remains, and the relatively large variation in types and raw materials, Kviteberg is interpreted as a residential site.

Of the total assemblage of 9134 items from House 2 and the activity area, more than 900 are classified as blades or blade fragments. This is an unusually high component in North-Norwegian assemblages. In addition, there were a variety of different tools like borers, burins, scrapers, as well as polished stone axe and fragments thereof as well as a large amount of macro tool preforms. Sixty per cent of the raw material is made up by different variants of chert of good quality. Blades were also produced from beach flint, and to a lesser degree of silicified sandstone and quartzite. There is a rich assemblage of conical cores with faceted platforms, core fragments, platform preparation flakes, and blades which leaves little doubt that the pressure blade concept was dominant. In addition, characteristic artefact types such as margin retouched blades and snapped rectangular blade fragments are also present. The site also includes two activity areas where production/shaping of macro tool preforms has taken place, both the preforms and the discarded ground tools have been initially shaped by bifacial reduction.

Tømmerbukt lies 13km south of Kviteberg, on the southern side of the Kvænangsfjord. Similarly, to Kviteberg, it is situated on gently sloping ancient beach terraces, but in a wide bay facing a narrow strait of the fjord. The site lies 34m asl. A shoreline date for an assumed contemporary sea level of 30–31m asl results in 7600–7500 cal BC (8500–8400 BP, isobase 20). 23.5m^2 were selected for excavation after a larger area was test-pitted. The surrounding negative test pits, as well as the excavated area, indicate that the occupation area was not very extensive. The excavation uncovered a very shallow semi-circular depression 3.0 × 3.0m in size, in which the lithic material was concentrated. The homogenous inventory and the delimited distribution of lithic scatter indicate that the site reflects a short-term occupation event. This involved most sequences of the operative chain of blade production – from initial shaping of smaller chert blocks, core-shaping, -maintenance, and -exhaustion, blade production and modification, as well as discard of undesired pieces. The blade production

unequivocally reflects the eastern blade concept, and the inventory contains no western/Phase 1 type artefacts.

At Tønsnes near Tromsø city, some 110km south-west of Kvænangen, several sites covering the Early Mesolithic to the Late Mesolithic have been documented (Grydeland & Finstad 2009; Skandfer *et al.* 2010; Gjerde & Hole 2013; Nergaard *et al.* 2016). However, the evidence is scarce for the time bracket 8500–7200 cal BC. Two sites have so far yielded information of eastern technology. Locality id. 104346 and id. 104342, excavated in 2008, are located on two low ridges, which once were small headlands on the southern and northern side of a 250m-long, shallow prehistoric bay. The sites are situated 28–30m asl, which gives a shoreline displacement date of *c.* 9000 BP, or 8200 BC (Grydeland & Finstad 2009: 23). On the basis of tanged points and a flake axe, Tønsnes id. 104346 was originally ascribed the western Phase 1 tradition (Grydeland & Finstad 2009: 28). However, a recent assessment by Rosenvinge resulted in the identification of several conical core-fragments and platform rejuvenation flakes, characteristic of the eastern pressure blade technology. The western/Phase 1 and eastern elements could be contemporaneous. The 699 artefacts seem to be concentrated to an area approximately 6.0 × 6.0m in size, and the site contained no dwelling remains, fireplaces or other structures. It is suggested that the assemblage represents a specialized activity area within a larger unknown site (Grydeland & Finstad 2009: 73), but it could also reflect an isolated short-term camp.

Tønsnes id. 104342 revealed a large rectangular house pit, with a sunken floor area of 10.8 × 4.0m, surrounded by sturdy wall-benches of sand and stones on three sides. Four similar houses were also found on two other sites at Tønsnes (Gjerde & Skandfer 2017). Radiocarbon dates show that the houses were occupied within the same period, between 7200–6500 cal BC. The house at id. 104342 was carbon dated to 6980–6480 cal BC (Skandfer *et al.* 2010: 62). The finds include single-edged points, blades, borers, burins, bipolar cores, and unifacial cores, which traditionally are placed in the western/Phase 1 context. However, a small number of conical core-fragments and platform preparation flakes, of which one has a part of the core front preserved, bear evidence of eastern blade production. A ground adze found in the eastern wall mound could also be related to the eastern elements. In 2011, a small supplementary excavation some meters southwest of the house pit uncovered an additional core tablet, as well as some blade fragments that possibly were produced from conical cores (Hood & Niemi 2011). Thus, the assemblage from id. 104342 most likely represents multiple episodes of occupation. The preboreal material does not correspond with the much younger radiocarbon dates from the house pit, and there are no other known

examples of large rectangular house-pits associated with eastern technology in Scandinavia (or beyond). The large pit house seems to be placed on an older settlement site, which has extended over much of the prehistoric headland. Unfortunately, it has not been possible to study the assemblage in detail, which is necessary in order to clarify the relation between the western and eastern elements, and the house pit.

Some 8 km southwest of Tønsnes, at the northeastern side of the island of Tromsø, Bergli 1 was excavated in 2010 (Grydeland & Arntzen 2014). The site was situated in sloping terrain, on the inside of a small promontory. At the time of occupation, the area provided excellent harbour conditions, and easy access to rich marine habitats in nearby tidal currents.

The excavations uncovered a round shallow depression (Structure 1), measuring 3.5m in diameter, which most likely represents a dwelling structure similar to the one at Slettnes IV A. An R-Combine (Oxcal v.4.3.2) of six radiocarbon dates (TRa-1895, TRa-1896, TRa-1897, TRa-1893, TRa-1894, TRa-1898) on charcoal from a central concentration dates the depression to 8460–8280 cal BC. Of the approximately 880 items associated with the dwelling structure, 850 were made of flint. The finds were most densely distributed within Structure 1. The assemblage contained 49 blades and fragments of blades, as well as at least seven complete or fragmented conical cores, including one core tablet. Backed blades indicate that the reduction sequence also comprised the initial stages of blade core shaping. Three fragments of ground macro tools as well as a complete ground axe were also found in or close by the dwelling structure.

A second structure was discovered 12–15m south of Structure 1. This was an area 4–5m^2 in size, filled with flat slabs and covering a layer of charcoal and ochre (Structure 2). On top of this layer, fragmented flint was identified. The structure is interpreted as displaying some form of symbolic behaviour (Grydeland & Arntzen 2014:56). Radiocarbon dating of charcoal samples collected from the lower parts of the structure resulted in 8500–7600 cal BC (TRa-1902: 8940±175 BP; TRa-1899: 8815±80 BP). A somewhat later use-phase during the time bracket 7000–6500 cal BC is evidenced by radiocarbon dating of three samples from charcoal spots partly covering the flat slabs. It is challenging to determine the relation between the lithic material and the two occupation events, inasmuch as the find bearing layer was excavated as a single stratigraphic context. A total of 1675 lithic items were collected from an area 94m^2 in size, including the structure. There was a marked concentration of finds associated with the structure. In addition to flint, which comprised 50 per cent of the raw material, a considerable amount of chert was present (34 per cent). However, 60 per cent of all blades, and 100 per cent of blades wider than 100mm, were of flint. The assemblage

included 60 cores, of which the majority is classified as bipolar or irregular cores. In addition, at least three fragmented conical cores were documented. One of the bipolar cores has remnants of blade detachments, indicated that this is a reworked conical core. Blade cores and blade morphology adhere to the eastern concept of blade production. Twenty artefacts were classified as ground axes, consisting of both complete and fragmented items. Six-seven fragments originate from hollow edged gouges. The majority of the ground macro tools, as well as preforms and modification debris, were closely associated with Structure 2.

During initial surveying in relation to a planned highway, two Mesolithic sites were found at Fauskevåg in Harstad, on the eastern side of the strait Tjeldsundet in southern Troms (Hole *et al*. 2016: 115–21). The distance between the sites is 70m. At the time of occupation, Fauskevåg 1 was located on the sloping bank of a small inlet directly south of a small promontory, while Fauskevåg 2 was situated on top of this promontory. At Fauskevåg 1, 89 items, mostly of flint, were collected from seven test pits. The finds included blades, snapped blades and a small conical core. Fauskevåg 2 produced fewer artefacts, but also here blades seem to have been produced from conical cores. With an elevation of 41–43m asl a shoreline displacement dating results in 7700–7600 cal BC for Fauskevåg 1. Fauskevåg 2 is situated at 46–47m asl, indicating a somewhat earlier age. However, the higher location could have been preferred due to the easy access to the shore from both north and south. This advantage could have outweighed the increased distance to contemporary shore. Consequently, the site could be younger than the implied shoreline date, and the two sites might even be more or less contemporary.

South of Troms, one of the few excavated Mesolithic sites is Skogveien at the Tjong peninsula in Rødøy, central Nordland. The site was investigated in 1992 and 1994 (Simonsen 1996). A 2.0 × 4.0m, large scatter of lithics surrounded a charcoal-rich packing of burnt stones. A charcoal sample from the site was dated for the purpose of this study, and yielded the date 8290–8220 cal BC (Beta-490876: 9010±30 BP). The material consists of 1252 artefacts, of which more than 99 per cent were of flint. The eastern concept of blade production is identified through a number of platform preparation flakes, exhibiting the characteristic facetted front, as well as complete core tablets, and fragments of conical cores. The assemblage contains very few blades and formal tools, only fragments of a few blade cores and no remains from the initial stages of blade production. This small site most probably represents a short-term camp, where some blade production from pre-prepared cores took place. Subsequently, the finished products were transported from the site. Of the seven implements in the assemblage, six are microliths (five lanceolate and one of the circle

segment type). The last implement is a corner burin. Two burin spalls indicate that such tools were made at the site.

The eastern technology is also documented from house pit 2 at the site Åsgarden 1 at the islands of Vega, Nordland (Holen 2018). A charcoal sample from the house pit yielded the date 7568–7141 cal BC (T-7790, 8330±90 BP) (Bjerck 1989:85). Characteristic artefacts typical of both the eastern and western/Phase 1 tradition (one-sided cores with one or two platforms, tanged and single-edged points and lanceolate microliths) were documented from the house pit (Holen 2018: 104). The eastern technology was also documented for the Middle Mesolithic shoreline dated sites Hestvik 2 (64–65m asl.), Moen 1 and 2 (65–70m asl.), Moen 85-1 and Skarvdalen 1 (68–70m asl.). Re-examination of Moen 1 and 2 also revealed artefact types representing both the eastern and western Early Mesolithic lithic production concepts (Holen 2018). The sites are located at approximately 60–70m asl. According to the shoreline displacement curve for the area the sites were shorebound during the Boreal period (*c.* 9000–8000 BP) (Bjerck 1990).

Apart from Sujala in northernmost Finland, all sites with eastern technology were located within close proximity of the contemporary coast. While there is very little preserved organic material that could have shed light on subsistence and resource use, it seems highly probable that marine resources, as well as seaway travel and transportation, were directive for the settlement pattern. The earliest known house pits in the region appear on sites that are associated with the eastern blade technology, as evidenced by Gusiny, Mortensnes R10, Stahrenjunni, Sæleneshøgda, Slettnes IV A, Bergli 1 and Kviteberg. Pithouses represent a marked break with the Early Mesolithic Phase 1 tradition, which was characterised by an opportunistic dwelling practice involving fully portable structures (Bjerck 2017; Fretheim *et al.* 2017; Nærøy 2017).

Our data demonstrates that at least until 8200 cal BC, eastern and western technologies were both present in the northernmost part of Fennoscandia. Microlithic armature, tanged points, flake axes, and blade- and flake production performed according to the western production concepts frequently occur on sites with eastern technology. Spatially distinct, but more or less contemporaneous, eastern and western assemblages at Gusiny could indicate that two technological groups coexisted in the region. For other sites, an "amalgamation" of the two traditions might seem more likely (see also Sørensen *et al.* 2013: 26–27). Some mixed assemblages could be palimpsests of several different occupation events, which convincingly has been argued for Sæleneshøgda (Woodman 1992; Anttiroiko 2015). For the majority of sites discussed here the main impression is, however, that western Phase 1 elements were

deposited during the same occupation events as the eastern components. This is further supported by sites, which are interpreted as small short term camps, where the topographic situation renders overlapping occupations less likely.

Eastern Fennoscandia and northern Sweden

In eastern Fennoscandia, the earliest sites representing the eastern technology are found in Karelia and southern Finland and comprise the earliest known sites in the area. Pressure blades, core tablets and core fragments on flint, representing the eastern technological concept, are known from the Jokivarsi 1 site dated to 9185–8490 cal BC by four radiocarbon dates on burnt bone and birch bark pitch (Pesonen 2012; Tallavaara *et al*. 2014), from Saarenoja-Muilamäki (8540–8280 cal BC: Jussila *et al*. 2012) as well as Povenchanka V (8530–7080 cal BC: Tarasov 2018), while the Saarenoja 2 (9125–8945 cal BC: Jussila *et al*. 2012) and Ristola (8250–7755 cal BC: Takala 2004) sites have also yielded surface retouched tanged points on blades (so-called post-Swiderian points).

Non-local raw materials are found at many of the earliest sites in eastern Fennoscandia, dated to *c*. 9000–8200 cal BC. At most sites, the blades are made on carboniferous chert imported from sources approximately 500–400km to the east (Hertell & Tallavaara 2011; Jussila *et al*. 2012). However, in the area of present-day Finland and Estonia, by *c*. 8000 cal BC the production of pressure blades ends and flake-based reduction technologies on local raw materials take over (Kriiska *et al*. 2011; Manninen & Hertell 2011; Tallavaara *et al*. 2014; Manninen *et al*. 2018).

In the area of present-day Finland simple flake production, mostly on macrocrystalline quartz, starts to dominate alongside a variety of ground stone tools on slates and igneous rocks already *c*. 8900 cal BC (Manninen *et al.* 2018: 30). The earliest sites with quartz flake production and no evidence of blade production or use, are Myllykoski in southern Finland *c.* 8800 cal BC (Takala 2004) and the Antrea net find site *c*. 8500 cal BC (Carpelan 2008). A variety of tool types of the so-called Ancylus Mesolithic (Matiskainen 1983, 1989), i.e. local cultural developments deriving from the earliest pioneer phase, characterize the period following the first centuries of postglacial human presence in the southern part of Finland. These tool types (curved-backed gouge, leaf-shaped slate point, and globular mace-head with coniform hole) have been dated mostly by shoreline dating to the Ancylus Lake stage of the Baltic Sea basin. The globular mace head, dated to *c.* 8100–7600 cal BC, has the most clearly defined distribution within these tool types.

Similarly, in northern Sweden and western Finnish Lapland, the earliest sites give evidence of the use of lithic technology mainly characterised by flaked quartz (e.g. Olofsson 2003; Knutsson & Knutsson 2012; Möller *et al.* 2012; Tallavaara *et al.* 2014). The earliest dates are from Aareavaara (9300–8640 cal BC), Kangos (8200–7600 cal BC), and Nuottijärvi 1 (8270–7960 cal BC), all close to the Swedish-Finnish border. Further south in Sweden Dumpokjauratj (7590–7370 cal BC) and Vojmsjön (8240–7615 cal BC) also represent a flake-based quartz technology (Table S1A). While the last remnants of the Weichselian ice cap continued to withdraw from northern Sweden and western Finnish Lapland, this area was, according to radiocarbon dated sites, settled by quartz using groups moving from the north-east towards the south.

Central and western Scandinavia

During recent years, the eastern blade production technology has been identified from a large number of sites in the area from Trøndelag in the north to Bohuslän in the south along the Scandinavian Atlantic coast and the Skagerrak region. However, from the central and western parts of South Norway available data are, so far, limited. Due to the Early Holocene Tapes transgression, only a few coastal sites dated to the first half of the Middle Mesolithic period (8300–6300 cal BC) have been excavated from these regions.

In central Norway the eastern blade technology is documented for the inland site Foldsjøen 4a located in a strait between the lakes Foldsjøen and Litlfoldsjøen in Trøndelag (Skar 1989; Holen 2018). Unfortunately, the site has yielded no absolute dates, but based on typological aspects a date to the first half of the Middle Mesolithic has been suggested (Skar 1989). A few Middle Mesolithic sites have also been excavated in Møre and Romsdal, northwestern Norway. The majority of the sites are, however, dated later than 7000 BC (Åstveit 2008). Due to the Tapes transgression, only single artefacts in the form of conical cores are known from sites shoreline dated to the first half of the period.

The earliest evidence of the eastern blade production concept from western Norway is from a cultural layer at the site Tangevika 24, Spissøy, Bømlo in Hordaland radiocarbon dated to 8285–7880 cal BC (B-95512, 8940±60 BP) (Anthonsen 1995; Kristoffersen & Warren 2001: 239; see also Nyland 2015). The eastern technology is also documented from seashore dated sites, such as the site Tjernagel 37 on Sveio in Hordaland dated to *c*. 8250–7600 cal BC (Bjerck & Ringstad 1985: 69) as well as the site Litla Skiftesvika 142 from Spissøy, Bømlo (Waraas 2001). Also, in south-west Norway the lack of sites predating 7500 cal BC makes it problematic to date the introduction of the eastern blade concept in this region. In Rogaland,

the, so far, earliest presence of the technology is documented for the site Sola 10, radiocarbon dated to 7910–7170 cal BC (T-5321, 8500±240; T-5528, 8370±129 BP), and Hå gamle prestegjeld, radiocarbon dated to 7600–6710 cal BC (T-7138, 8430±170; T-5972, 8140±90; T-7173, 7950±90 BP). The lithic inventories from the sites are characterized by a rich assemblage of conical/sub-conical cores with faceted platforms, core tablets, platform preparation flakes, and blades produced by means of pressure and indirect percussion techniques (Damlien 2016a).

The most comprehensive data of the eastern blade technology in western Scandinavia originates from sites located in the coastal areas of south-east Norway (Damlien 2016a). Large-scale excavations in this region have produced a series of sites from the Early and Middle Mesolithic periods (e.g. Stene 2010; Solheim & Damlien 2013; Melvold & Persson 2014; Solheim 2017). Due to the considerable land uplift after the last Ice Age, the sites are located high above present sea level in forested areas, and represent chronologically undisturbed occupations in succession (Damlien 2016b). The sites are diverse in layout and intra-site organisation and seem to represent different settlement types and activities, varying from extensive residential sites to specialised, short-term occupation sites of mobile character (Solheim & Damlien 2013; Solheim 2017).

The majority of the excavated sites are located at the western shore of the Oslo Fjord in Vestfold and Telemark Counties. The earliest presence of the eastern blade production concept in this region as reflected by radiocarbon-dated sites, is documented from the Langemyr site (65–70m asl) in Larvik, Vestfold (Koxvold 2018). A burnt hazelnut shell obtained from the central find concentration was dated to 8200–7800 cal BC (Ua-52063, 8853±43 BP). The lithic material comprises 2572 lithic artefacts primary of flint distributed within one lithic scatter. Blade morphology, core tablets with faceted platforms from conical cores are clear evidence of the eastern blade technology. Of a slightly younger date sites holding the eastern blade technology is the nearby sites Hovland 5 (Ua-45490, 8775±52 BP, 7950–7740 cal BC) as well as the shoreline dated sites Anvik (8400–8200 cal BC), Hovland 2 (8400–7900 cal BC) and Nordby 2 (7900–7500 cal BC) (Solheim & Damlien 2013; Eymundsson & Mjærum 2014; Damlien 2016a).

The most comprehensive documentation of the eastern blade concept relates to the site Hovland 3 located on a sloping terrace, 59–62m asl (Solheim & Olsen 2013). The site was investigated in 2012 and contained a dwelling structure in the form of 12 m^2 large oval depressions with a central hearth. Eighteen radiocarbon dates from the culture layer and structures related to the house pit was dated to 7620–7450 cal BC (Table S1a). Altogether

21,381 lithic artefacts were retrieved from inside and outside the house pit, showing extensive blade production from conical and sub-conical cores with faceted platforms alongside with artefacts associated with the eastern technological concept, such as barbed microliths (hulling-type), microblades with semi-abrupt lateral retouch, and ground macro tools (Røe 2015; Damlien 2016a).

In addition to the radiocarbon dated sites, the eastern blade technology is documented at coastal sites dated by shore displacement curves to *c*. 8400–8200 cal BC, thereby suggesting an even earlier presence of the pressure blade concept in Southeast Norway. The site Darbu in Buskerud, located *c*. 118m asl in today's cropland, is dated according to shore displacement to *c*. 8600–8300 cal BC, most probably *c*. 8450 cal BC (Eymundsson & Gaut 2013). 769 lithic artefacts, comprising mostly of flint, were recovered within one cluster. Standardised and regular blade production from conical and sub-conical cores by means of pressure and indirect percussion techniques was the dominant strategy for blade production.

Other recently excavated sites with the eastern blade technology are Hydal 3, Hydal 4, and Hydal 7 in Telemark dated by shore displacement chronology to 8300–8000 BC (Solheim 2017). The site Hydal 3 is especially interesting in this respect. The assemblage comprises of 1254 lithic artefacts mostly of flint scattered within one concentration. Technological analysis shows that the flint material derives from blade production utilising conical cores with faceted platforms and a platform angle close to 90˚. In addition, two core axes of flint and one possible flake axe were retrieved from the site (Koxvold 2017). Flake axes are normally assigned to the Early Mesolithic western technological tradition in this region.

From the eastern side of the Oslo Fjord the earliest site with pressure blade technology yielding radiocarbon dates is the Tørkop site excavated during several occasions in 1974–1975 (Mikkelsen 1975). In 1975, the site was used as a basis for establishing a separate Mesolithic, *Phase 2* in the chronology of East Norway. Three radiocarbon dates give the range 8180–6860 cal BC for the site's use (T-2134, 8790±100 BP; T-2194, 8590±140 BP; T-1872, 8180±170 BP), while the site is interpreted to represent two short-term visits, during the periods *c*. 7700–7600 cal. BC and *c*. 7200–7100 cal. BC (Mikkelsen 1975). The material comprises 4802 lithic artefacts, nine pieces of secondary modified bone and 2025 burnt bone fragments. The lithic assemblage contains clear evidence of the eastern technology and related artefact types (Damlien 2016a).

During recent years, the eastern blade technology has also been documented in the interior areas of Southeast Norway. The earliest sites Knubba, radiocarbon dated to 8150–7445 cal BC (Beta-216497, 8780±80; T-18132, 8595±120; T-18133, 8545±120) (Amundsen 2007),

and Bjørkeli, OSL-dated (optically stimulated luminescence) on fire-cracked rock from a hearth in one of the find concentrations to 10 800–7900 cal BC (X3226, 11270±710 cal BP) (Damlien 2010), show clear evidence of the eastern blade production concept. Contrary to the coastal sites, quartzite, jasper, and quartz were the main raw materials used for tool production. Flint comprises only a limited amount of the assemblages. Variation is also observed in technological strategies. Although blade production by the pressure blade concept dominates, flake production from platform- and irregular cores, as well as bipolar production on anvil, were important technological strategies (Damlien 2010, 2016a; Damlien & Solheim 2018).

The earliest evidence of ground macro tool techn ology is found at the coastal sites Hegna vest 1 (Ua-50485, 8788±34 BP, 8167–7717 cal BC; Ua-514622, 8732±40, 7938–7608 cal BC) (Fossum 2017), Hegna vest 3 (Ua-51471, 8679±39 BP, 7790–7595 cal BC) (Eigeland & Fossum 2017) and Hovland 4 (Ua-45500, 8747±64 BP, 7938–7657 cal BC; Ua-45499, 8630±49 BP, 7680–7587 cal BC, Ua-45493, 8568±51 BP, 7590–7541 cal BC, Ua-45494, 8526±52 BP, 7590–7541 cal BC) (Mansrud 2013b) all with radiocarbon dates falling between *c*. 8170–7600 cal BC. These macro tools only display traces of modification by grinding, while the earliest sites Sundsaasen 1 (7900–7700 cal BC, shorelevel) (Eggen 2014), Prestmoen 1 (Ua-45178, 8593±46 BP; Ua-45177, 8620±45 BP; Ua-45176, 8671±45 BP) (Persson 2014), Nordby 2 (7900–7500 cal BC, shorelevel) (Koxvold 2013), which also contain pecked and ground macro tools, are dated by shore displacement to *c*. 7900–7700 BC.

In the coastal areas of west Sweden, the eastern blade technology and associated artefacts have been documented for a large number of sites related to the Sandarna period. The earliest documentation of the eastern blade technology is from the deep pit context at the site Huseby klev site. Nine radiocarbon dates on hazelnuts and birch bark pitch from the deep pit gave the range *c*. 8200–7600 cal BC (Ua-6044-5, Ua-6364, Ua-6408, Ua-6412-14, Ua-6413, Ua-56731; 8940±85 to 8615±85 BP) (Nordqvist 2005; Kashuba *et al*. 2019). The eastern blade technology is also documented for the slightly younger sites Bua Västergård (U-2611, 8560±130 BP, 7790–7440 cal BC) (Nordqvist 2000; Damlien *et al*. 2018) and Herrestad (Ua-44119, 8559±46 BP, 7600–7550 cal BC) (Andersson *et al.* 1988; Damlien *et al.* 2018) in Bohuslän.

The available radiocarbon dates indicate that the pressure blade technology was introduced to central and western Scandinavia around 8285–7950 cal BC, whereas the shoreline-dated sites indicate a somewhat earlier introduction, *c*. 8300 cal BC (Damlien 2016a). Technological

analysis of lithic assemblages from western Scandinavia (Damlien 2016a; Damlien *et al*. 2018) clearly indicate a definite and distinct division between the western and eastern blade production concept regarding core management and maintenance, blade blank production and blade tool manufacture. No sites representing an intermediate technology or yielding a mix of both technologies, that could reflect a co-existence of two culturally distinct technological traditions, have been found in this region. Moreover, distinct differences are found in projectile point morphology. While tanged points and geometric microliths produced by microburin technique dominate in the Early Mesolithic western technological concept, the sites dated after 8300 cal BC with the eastern technological concept, are characterised by an absence of tanged points, a very low frequency of geometric microliths, and a lack of the microburin technique (Mansrud 2013a; Damlien 2016a). Dominating the lithic assemblages are blades and blade fragments with the distinctive semi-abrupt lateral retouch on one or both edges, together with medial fragments with perpendicular breaks suggesting intentionally snapping of blades into rectangular segments (Damlien 2016a: 416).

The blade technology also seems to have been part of a technological package including composite bone tools (see Persson *et al*. 2019; Knutsson *et al*. 2016) and ground macro tool technology (Anttiroiko 2015; Nyland 2015; Eymundsson *et al*. 2018). The earliest evidence of macro tools modified by grinding in central and western Scandinavia is from sites radiocarbon dated to *c.* 8170–7600 cal BC, while modification by pecking occurs on sites shoreline dated from *c.* 7900–7700 BC (Eymundsson *et al*. 2018). A delay of about 150–100 years is, thus, observed in the introduction of ground macro tool technology and an even further delay in the occurrence of pecked macro tools, the latter of which seems to represent a regional innovation.

Central Sweden

Central Sweden was still covered by ice during the Preboreal, but may have been colonised by both fauna and humans soon after deglacialtion, in the Early Boreal period. So far, the data at hand show that it was the bearers of the Middle Mesolithic eastern lithic tradition that pioneered this landscape.

Recent analysis of stray find collections (Knutsson & Knutsson 2012) and excavations of archaeological sites, has revealed the eastern blade production concept in the county of Dalarna, and part of the counties Härjedalen, Hälsingland, Gästrikland and Västmanland coinciding in time with the change in lithic technology in western Scandinavia, but based on local igneous rocks like porphyry, tuffites, quartzite and jasper (Falkenström 1996; Knutsson

et al. 2003; Guinard & Vogel 2006a, 2006b; Lindberg & Sandberg 2010; Knutsson & Knutsson 2012; Torfgård 2013; Wehlin 2014a, 2014b; Söderlind 2016).
The earliest radiocarbon date of this technology comes from the site Orsandsbaden, Leksand Raä 2001, excavated periodically in 2010–2016 (Ua- 38765, 9060±120 BP; Ua-48269, 8272±52 BP). The finds include pressure blade cores, core tablets and core preparation flakes in local porphyritic tuff. Other, slightly younger sites (Limsjön, Leksand raä 405, Oreälven, Orsa raä 527) in the same area have also yielded finds of the pressure blade technology. Limsjön, just 2km east of Orsandsbaden, has a mixed Middle and Late Mesolithic assemblage, while one of the several dates covers the period before 7500 cal BC (Wehlin 2014a) (Ua-46095, 8392±68 BP; Ua 56093 8301±53 BP; Ua-47095, 8430±58 BP), the earliest dates are from calcined reindeer bones. The site Oreälven has also a mixed Middle Mesolithic to Neolithic find material including a pressure blade core and core tablets, while radiocarbon dates indicate a use-period later than 7500 cal BC (Ua-50560, 7970±53 BP to 4033±42 BP).

Southern Sweden

Southern Sweden opened for settlement already in the Late Glacial, and alongside the Early Mesolithic Hensbacka sites of the west coast (Kindgren 1995; Nordqvist 2000), a few key sites in central South Sweden supply evidence of an early inland settlement in this time period. Radiocarbon dated sites include Motala Kanaljorden in northern Östergötland county, a multilayered site with a use-span from the Preboreal to the Subboreal climatic period, and Almeö, a peat blanketed site from the late Preboreal on the eastern shore of the Hornborga lake in the county of Västergötland.
An analysis of the lithic assemblages found in the site stratigraphy of Kanaljorden (Hallgren 2018) shows that a few features in the lowermost layers of the palimpsest of cultural remains in the settlement area, are characterised by a Preboreal western lithic tradition including microburins, lancet microliths and a frontal piece of a two-poled one-sided blade core. This shows an initial Maglemosian/Hensbacka settlement period in this part of southern Sweden no later than 9200 cal BC (Hallgren 2018).
The other blanketed and securely dated Preboreal site, Almeö (Hornborga 96B) at the former shore of lake Hornborgasjön in central Västergötland, is characterised by a technology of Early Maglemosian type, based mainly on West Scandinavian flint (Kindgren 1995) The fossil fauna consists of fish (such as pike and perch) and big game including aurochs, elk, roe

deer, red deer, wild boar and beaver (Arnesson-Westerdahl 1985). This site is dated by twelve radiocarbon dates to between *c*. 9300 and 8000 BC (Table S1a).

A number of sites found during surveys in the same area of southern central Sweden (Kindgren 1996b) adds strength to the evidence indicating that groups of the Epi-Ahrenburgian/Early Maglemose tradition settled ice-free areas of southern Sweden, including the inland, at the same time as groups with the same lithic tradition settled the western coast all the way up to northernmost Norway. In southern Sweden, this substrate forms the backdrop against which the cultural change that introduced the eastern technology at the Early Mesolithic/Middle Mesolithic transition in western Scandinavia happened.

The eastern pressure blade concept in southern Sweden (Damlien *et al.* 2018; Guinard 2018; Sørensen 2018), however, is mostly detected as cores in stray find collections (Guinard 2018). The earliest securely dated context with eastern blade production, Ytterbergs udde (Hornborga 97B) is located approximately 1km from the Almeö site. The culture layer was found in the upper part of a sand layer covered by a layer of peat that started to grow *c*. 8300–7600 cal BC (St- 8740±120 BP). A hearth containing charcoal and calcined bones within an area interpreted to be a hut floor, was dated to 8700–8330 cal BC (Table S1a). The hut floor area yielded also knapped Senonian flint with evidence of eastern pressure blade technology, including blades/microblades, a few blade/microblade cores, microliths, burins and scrapers.

In the bottom sediment of a small lake adjacent to the above discussed Kanaljorden site, a sequence of cultural deposits forms a stratigraphy spanning from the early Middle Mesolithic to the Subboreal. The find context of the lower Preboreal peat date to *c*. 9200 cal BC (Hallgren 2018: 229), contains regular blades and microblades of south-west Scandinavian flint, produced by indirect punch technique. This may suggest a very early introduction of the eastern blade production concept from the east across the Baltic Sea Basin (Hallgren 2018: 327).

Besides these well dated contexts, and a number of other non-stratified sites dated to the Middle Mesolithic, a large number of stray finds in museum collections give evidence of the presence of eastern technology in southern Sweden. Platform preparation strategies vary as indicated by plain versus faceted core platforms (Damlien *et al*. 2018; Guinard 2018; Sørensen 2018). An east–west spatial divide has been documented to follow water drainage systems. Blade cores with flat platforms are found along waterways connected to the rivers Nissan and Lagan, which flow towards the west coast, while faceted core platforms can be found in the south-eastern region, along waterways flowing towards the south-east. The people who lived along the two different drainage systems apparently used different concepts

for making regular pressure blades. The distribution of cores with plain platforms extends through southern Scania to Denmark (Sørensen 2018). An east–west divide in platform preparation technology is evidenced also in Scania by the Rönneholm Bog sites, where plain platforms are present, while faceted platforms are found at the Viss Mosse bog site, approximately 30km to the east (Sørensen 2018). Other sites with faceted blade cores and related material indicative of the 'eastern' concept include Sjögestad, Raä 232 Vreta kloster (UA-29263, 9359±487BP; UA-29262, 8854±224BP: Carlsson 2017: 336), Norje Sunnansund (*c*. 7500 cal BC: Kjällquist *et al.* (2016), and the undated Damm 6 site (Guinard 2018: 284).

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