Inland Mesolithic settlement in Central Jutland

What we have learned from the Lake Bølling Project and other Mesolithic investigations

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ABSTRACT

In Central Jutland there are many traces of settlement throughout the Mesolithic, mostly represented by flint scatters. Yet we do not have a good understanding of the inland Mesolithic, since many sites are palimpsests with mixed flint assemblages from multiple visits making them hard to date and classify. Over the past decades Museum Midtjylland has excavated sites that help elucidate the inland settlement complex and variation through time. Especially the Lake Bølling project has yielded undisturbed sites with preservation for some organic materials making radiocarbon dating possible. This paper presents the overall results from the Lake Bølling project including a short presentation of sites yielding radiocarbon dates. The overall results are used as a starting point for discussing the inland Mesolithic in general, suggesting a change in settlement pattern and intensity as well as increased regionalisation from the onset of the Early Atlantic.

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Introduction

There are numerous traces of inland Mesolithic settlement in Central Jutland. In the territory covered by Museum Midtjylland, which includes the parishes around Herning; Ikast; Brande; Ejstrupholm and Nørre Snede, circa 170 localities with flint attributable to the Maglemose, Kongemose and Ertebølle cultures are registered (Figure 1). Despite the many known sites, we still do not have a good understanding of the inland Mesolithic in the area. Over 100 of the sites are known only from surface collected worked flint. Moreover, many sites are palimpsests, a mix of components from multiple periods. Of the sites that have been excavated, it is rare to have preserved features or even cultural layers, and similarly it is rare to have preserved organic materials. Mesolithic artefacts made from perishable materials are quite few and were primarily found during the heyday of peat-digging. Flint is the primary source of knowledge, which means we are usually limited to relative dating, which can be problematic. One of the challenges is that the chronological framework for the Danish Mesolithic, except for the Early Maglemose, is based on finds from eastern Denmark and/or the coasts (Christensen 2017, 155; Khan 2023, 29; Rysgaard *et al.* 2016, 72; Petersen 1967, 1973; Petersen 1984; Sørensen 2006). Central Jutland is a main area for the so-called Gudenaa culture (Mathiassen 1937). When this phenomenon was revised and conclusively rejected as an independent culture in 1971 (Andersen and Sterum) it was accomplished by demonstrating that it was a mix of flint assemblages from the Maglemose, Kongemose, and Ertebølle cultures along with Neolithic material. The Mesolithic artefact types, primarily projectile points, correspond to those in eastern Denmark (Andersen and Sterum 1971, 23). However, the assemblages from the inland sites in Jutland are missing several diagnostic artefact types, for example conical cores and handle cores, just as the pressure technique seems absent. Thus, it can be extremely difficult to place a flint assemblage more precisely in the common typo-chronological framework based on diagnostic artefacts other than projectile points, as well as technological features, except in a very broad sense. Over the last few decades, Museum Midtjylland has focused on the inland complex by actively searching for and excavating Mesolithic sites (Møbjerg 2011; Christensen 2017,155). A focus on locating new

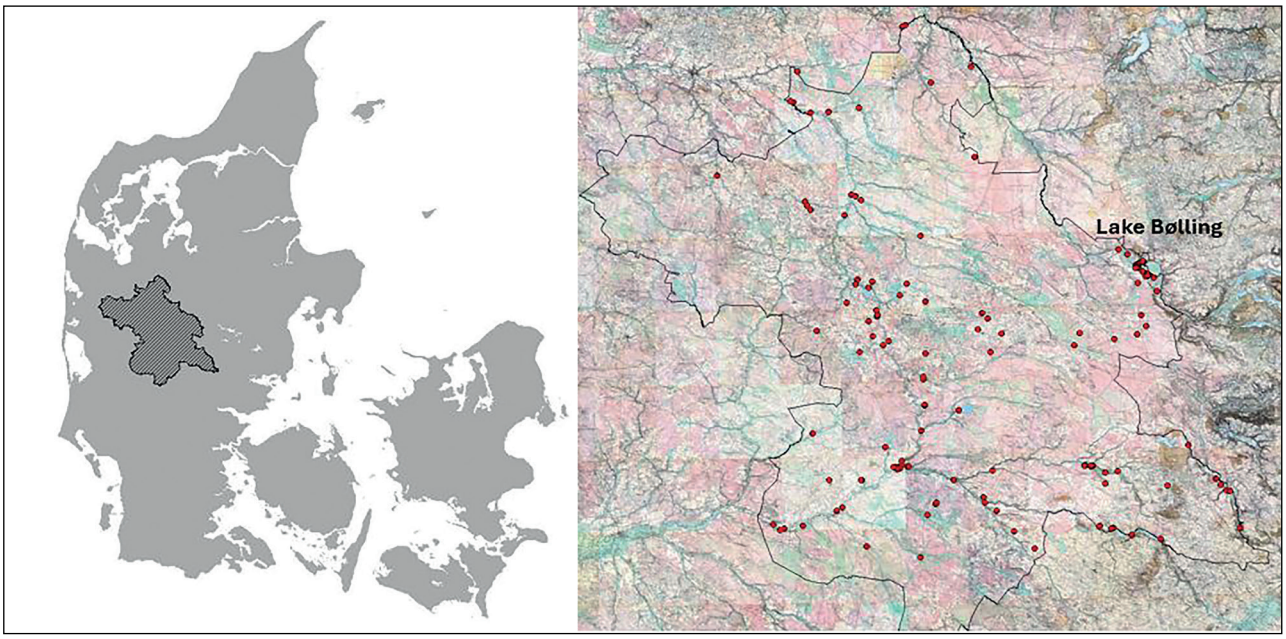

Figure 1. The study area in Central Jutland. All Mesolithic sites currently registered in the national Danish database of prehistoric sites, Fund og Fortidsminder, in the study area are shown on the topographical map from the late 19th century demonstrating a preference for wetlands and streams.

sites, combined with modern excavation methods and meticulous documentation, supported by various natural science and flint analyses, has resulted in both single component sites that allow for dynamic technological classification as well as sites that can be radiocarbon dated (*e.g.* Khan 2023). However, absolutely dated Mesolithic inland sites and assemblages in Jutland are still a rarity. However, the comprehensive investigation of 'a whole Stone Age landscape' in the western part of the Lake Bølling area has produced sites and conclusions that are a good starting point for discussion of inland Mesolithic settlement in a broader perspective. Over the years some of the sites and preliminary results from this campaign as well as a few other locations have been published (Andersen 2007; Andersen 2008; Andersen and Møbjerg 2009; Christensen 2008; Jensen and Møbjerg 2007; Khan 2023; Møbjerg 2005; Møbjerg 2006; Møbjerg 2008a, 88-89; Møbjerg 2011; Møbjerg and Christensen 2006; Møbjerg and Rostholm 2006), but in general there is a lack of comprehensively published sites and especially absolute dates that can help us come further. The aim of this article is to provide an overview of the results and radiocarbon dates from the Lake Bølling investigations and use them as a key to further elucidate the inland Mesolithic settlement in Central Jutland.

Traces of Mesolithic settlement in Central Jutland

In Central Jutland, Mesolithic sites are typically found along the larger waterways and lakes, sometimes also in higher lying terrain but still in connection to wetlands (Christensen 2017, 155). The study area covers part of the older moraine landscape up to the central Jutland Ridge in the east, a landscape marked by heath, old morainic hills, and outwash valleys that contain some of the larger rivers and streams of Jutland: Skjern Å, Storå, and Karup Å, alongside which Mesolithic sites are typically found. This was already recognised in the 1930s and 1940s after comprehensive reconnaissance campaigns along these and other waterways found extensive traces of Stone Age settlements, especially along the Gudenå River and its tributaries, which lent its name to the Gudenaa culture (Mathiassen 1937; Mathiassen 1948, 32-44). These survey campaigns resulted in approximately 30 sites in the study area (Rostholm 1982, 12). Especially the shorelines of former Lake Bølling, then a large bog, provided flint from several Mesolithic sites (Mathiassen 1937, 63). The most important was the Klosterlund settlement, the first undisturbed Mesolithic site with cultural layers and flint artefacts protected by a covering layer of peat. It

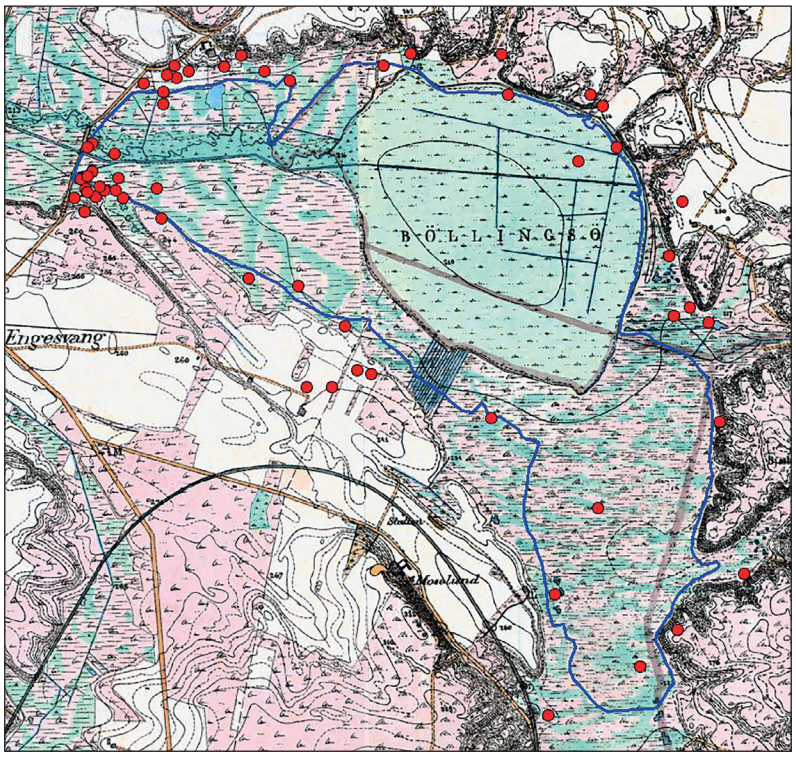

Figure 2. Map of Lake Bølling and the topography of the tunnel valley in which the lake formed. This map from 1871 shows the extent of the lake at this point in time. The restored lake is marked with a blue line. Red dots mark Mesolithic sites with flint artefacts.

was the oldest site in Denmark when excavated in 1936, and it became the type site for the Klosterlund culture (Mathiassen 1937,132-151). Although later recognised as part of the Early Maglemose complex, this site is still important and often highlighted when discussing the Early Mesolithic in Jutland (e.g. Petersen 2009, 115-116; Sørensen *et al.* 2018, 317). One reason is that the lithic assemblage has been comprehensively published (Petersen 1967, 107-127) and for a long time it was one of the only Early Mesolithic sites dated by means of natural science. The combination of an undisturbed, *in situ* flint assemblage with absolute dates is a dream scenario. But the Klosterlund settlement is no longer an isolated example. As part of a large nature restoration project aiming to restore Lake Bølling to its former Late Glacial size, several undisturbed sites covered by peat were found, especially from the Maglemose culture, including sites both earlier and later than the Klosterlund settlement (Rostholm 2001). This allows for a new perspective on the classic site, setting it in a broader framework and providing the chance to evaluate the Mesolithic settlement at Lake Bølling in a wider perspective.

The Lake Bølling complex

Landscape and topography

Lake Bølling is situated on the Jutland Ridge that constitutes the border between the older and younger glacial tills in Central Jutland. The lake lies higher above sea-level than any other lake in Denmark and constitutes a watershed between major drainages: the Karup Å system running northwest (today emptying into the Limfjord), and the Gudenå system running east (today with its outlet into the Kattegat). It has been a key environmental transition zone in the landscape since at least the Mesolithic. After the retreat of the ice at the end of the Late Glacial, a large, shallow lake was formed in the broad, steep-sided tunnel valley (Figure 2). The lake was still quite large during the Preboreal and Boreal although with decreasing extent as bog vegetation replaced open water - especially in the narrow and westernmost part of the basin. During this time the broad western outflow was gradually reduced to a narrow stream. By the end of the Boreal the low glacial terraces of the lake were covered by peat growth, and from the end of the Atlantic period a raised peat bog started to form. The peat bog subsequently covered most of the valley, reducing the lake to the size known until historic times (Aaby 2006a). In the late 19th century the

area was drained for agriculture but was found not to be suitable for this purpose. Up until 1970 the area was instead utilised for peat-cutting, with the most intensive use during the 1940s. This resulted in multiple Mesolithic single finds (Rostholm 2001, 71). Since the 1970s reflooding the basin was discussed and in the 1990s it was decided to restore the lake to its former condition, covering an area of 360 hectares, yielding a slightly higher water table than in the Late Glacial when the lake was at its largest (Rostholm 2001, 82-84). This project led to a major archaeological campaign that was concluded in 2004, followed by re-flooding of the lake basin in 2005.

Archaeological investigations

The archaeological investigations preceding the reflooding greatly increased the number of known Mesolithic sites in the area, especially along the shores of the prehistoric lake. The entire lake basin was investigated but most sites occurred in the westernmost part of the area, where the sites were best preserved (Møbjerg and Rostholm 2006, 148). Sites cluster in the narrowest part of the valley at the natural crossing point of the lowlands (Figure 2), where the Klosterlund settlement is also situated.

They are located on the sandy, late-glacial terraces along the prehistoric lakeshore and on the peat surface in the lake basin proper, especially by the western outlet (Møbjerg and Rostholm 2006, 148). The presence of multiple peat-covered undisturbed sites allowed for radiocarbon dating of several of them. Palynological analyses enabled relative dating of some sites as well as ecological reconstructions of the immediate surroundings (Aaby 2006a). All sites in the western lake basin affected by the reflooding were fully excavated, but those on the late glacial terraces that were not going to be submerged were only tested or partially excavated. However, one of the sites above the new lake, Dværgebakke I, showed great scientific potential yielding occupations from the Ahrensburgian through the Early Maglemosian and was therefore fully excavated (Møbjerg and Christensen 2006). The classic Klosterlund settlement, located in a similar topographical position on the opposite shore, holds status as a protected site, and was not going to be affected by the reflooding. However, the area in front of the classic settlement was going to be submerged and was thus investigated in order to detect potential refuse layers (Møbjerg and Rostholm 2006, 152-153). Following the conclusion of the field campaign, some of the preliminary results and radiocarbon dates were published (Møbjerg and Rostholm 2006, table 1), but more radiocarbon results have since been added. Dynamic technological flint analyses have been carried out with a focus on the Maglemose sites (Andersen 2010) as well as preliminary studies of the rather large but mixed flint assemblage from the Dværgebakke I site (Sørensen 2007). The combination of flint studies and radiocarbon dates, as well as palynological analyses, makes it possible to discuss the Mesolithic settlement in the western part of the Lake Bølling basin in a broader perspective. Here follows a short presentation of sites that have yielded radiocarbon dates and/or have been dated by palynological analyses (Figure 3). The aim being to publish sites with radiocarbon dates which can be incorporated into further studies of the inland Mesolithic.

Dværgebakke I

The site is situated on the sandy, low, late glacial terraces right above the prehistoric lake. It consists of approximately 27,000 pieces of worked flint covering an area of 15 x 20 m. Preliminary lithic analyses have demonstrated that the site has been recurringly occupied. Based on the distribution of flints, especially diagnostic projectile points, at least eight occupations are suggested, dating from the Ahrensburgian through the Early Maglemose period (Sørensen 2007) with a somewhat horizontally spread but overlapping distribution. The Ahrensburgian occupation(s), the oldest traces of occupation at Lake Bølling, is represented by tanged points and larger blades and blade scrapers (*e.g.* Møbjerg and Rostholm 2006, fig. 6) made of good quality flints. Moreover, this part of the assemblage is wind polished (Sørensen 2007). This was followed by recurrent occupations in the Early Maglemose (phase 0-2), represented by diagnostic microliths (ranging from simple lanceolate forms to isosceles) and smaller cores, blades and formal

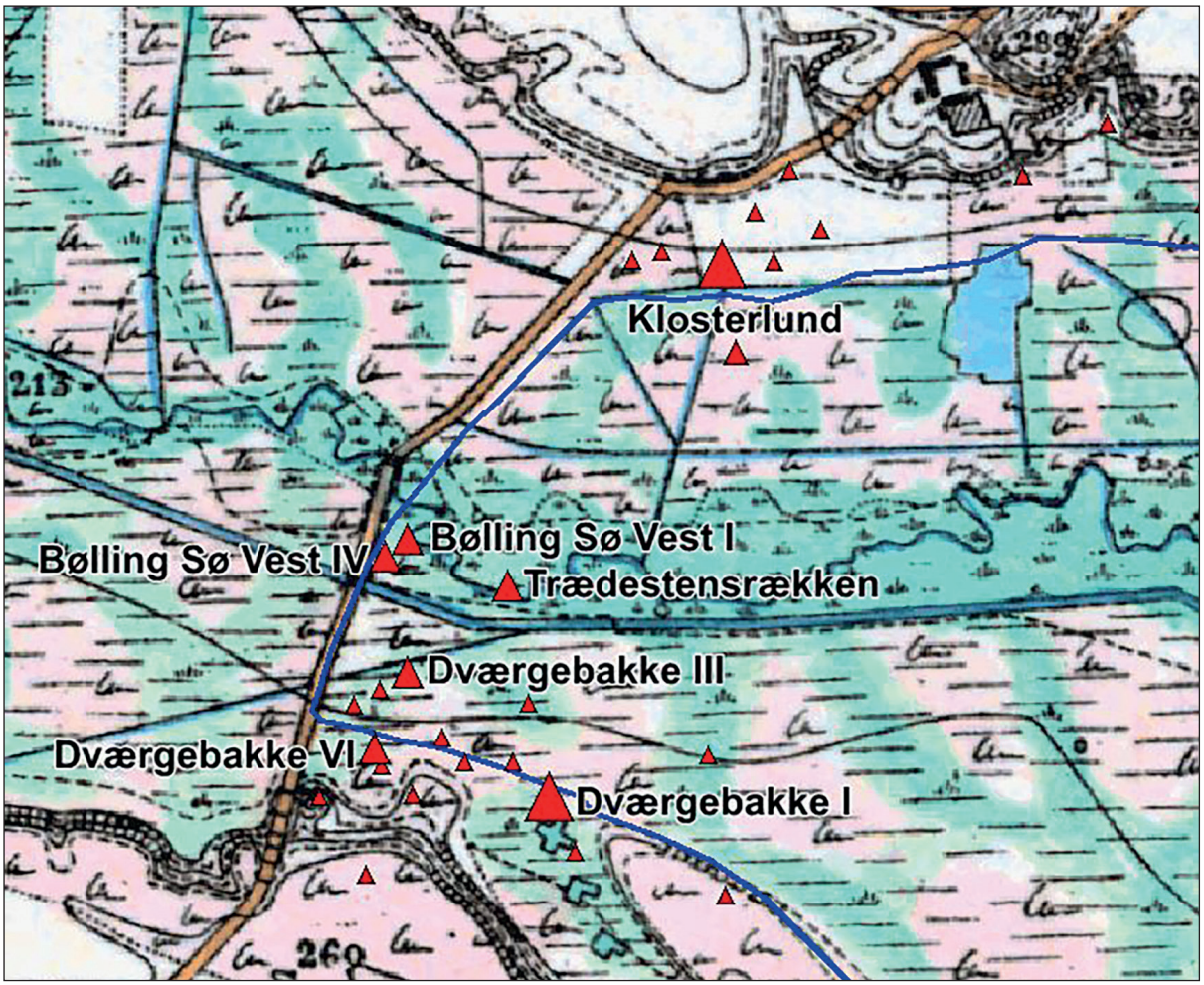

Figure 3. Overview of the Mesolithic sites at the western end of Lake Bølling with emphasis on radiocarbon dated sites presented in this paper.

tools made of the local moraine flints (Sørensen 2007). Overall, the Maglemose blade industries can be ascribed to the Maglemose techno group 2 characterised by smaller blades produced by means of direct soft stone hammer technique (Sørensen 2006, 63). A large number of 'pressure-flaking tools' of Matte Danian flint were found in association with the latest occupation phase, represented by isosceles microliths. These tools are clearly both produced and used on site. Matte Danian flint is in general not a preferred raw material for tool production in the Mesolithic, and at Dværgebakke I it is only used for this one particular tool type, the possible function of which has been discussed elsewhere (Andersen 2008). A few flakes of Matte Danian were found on several other Early Maglemose settlements in the area, but the Klosterlund settlement is the only other site where a tool fragment of this raw material has been found (Petersen 1967: 122, fig. 87a). In association with the Maglemose occupations, exceptional finds of three lumps of birch pitch with human dental marks were found (Møbjerg and Christensen 2006, 15-18), one of which is radiocarbon dated (Table 1: AAR-10921). Six additional samples were radiocarbon dated throughout the site (Table 1). Since the site represents multiple occupations and the lithic assemblages are overlapping, the individual samples cannot be linked to specific phases but represent the use of the site in a broad sense. Palynological analyses conclude that the site was covered with peat in the Late Boreal/Early Atlantic period (Aaby 2006b, 24; Aaby 2006c,18), thus yielding a relative *ante quem* date for the occupations. This agrees with the relative typology provided by flint analyses.

Dværgebakke III

The site is located in the lake basin on the peat

Site + sample no.	Lab.no.	Material	Context	C14-age BP	Cal BC (68,3 %)	Cal BC (95,4%)
2981x3310	AAR-10794	Charred leaf	Culture layer w/flint	9600 +/- 110	9199-8825	9264-8648
2981x906	AAR-8343*	Charcoal (*Pinus sylvestris*)	Feature w/charcoal	9335 +/- 65	8708-8478	8764-8346
2981x3191	AAR-10921	Pitch (*Betula sp* .)	Lump of pitch w/dental marks	9205 +/- 55	8533-8311	8561-8291
2981x5589	AAR-10793	Charcoal (*Corylus avellana*)	Culture layer w/Matte Danian flint	9141 +/- 49	8425-8285	8540-8272
2981x687	AAR-9818	Charcoal (*Pinus sp.*)	Culture layer w/flint	9005 +/- 70	8294-8014	8336-7950
2981x3044	AAR-10795	Organic material (soil sample)	Culture layer w/flint	8890 +/- 55	8206-7959	8246-7820
2981x2119	AAR-9819	Charcoal (*Pinus sp.*)	Feature w/charcoal	8850 +/- 65	8198-7831	8232-7742

Table 1. Radiocarbon dates from the site Dværgebakke I. Calibrated in OxCal v.4.4 (Bronk Ramsey 2009) using the IntCal20 calibration curve (Reimer et al. 2020).
*This sample was originally published in Møbjerg and Rostholm 2006, table 1.

surface near the western outlet of the lake. It consists of approximately 1500 pieces of worked flint distributed as three closely spaced lithic scatters centred on two clay-built hearths (Rostholm 2001, 74; Møbjerg and Rostholm 2006, 156-157). The assemblage is typologically and technologically homogenous, suggesting a short lived, single event occupation. The tool assemblage includes 21 uniform, relatively large, simple lanceolate microliths, which place the assemblage in the Early Maglemose (phase 0) (Andersen 2010, 36-37). The predominance of single and dual platform cores and blades produced by direct percussion are characteristic of Maglemose techno group 2 (Sørensen 2006, 63). The tool assemblage is dominated by crude edge burins and small flake scrapers but also contains two asymmetrical flake axes. Typologically, the assemblage appears older than the Klosterlund settlement. The distribution of microliths and microburins, as well as other formal tools, suggest activity zones centred on the hearths (Møbjerg and Rostholm 2006, 156-57). Originally, three samples were radiocarbon dated, one charcoal sample from each of the hearths as well as a charcoal sample associated with worked flint in the cultural layer (Table 2: AAR-8341, AAR-9835-36). Later, three additional samples from one of the hearths were radiocarbon dated (Table 2: AAR-33632-634) as part of a master´s thesis project (Christensen 2021, 72-73). Despite the fact the flint assemblage appears typologically homogenous, the radiocarbon dates on charcoal fall into two separate groups. Regardless, the Dværgebakke III site represents one of the oldest settlements found at Lake Bølling.

The Klosterlund settlement

Partially excavated in 1936-37, this large settlement yielded approximately 30,000 flint artefacts covering an area 20 x 80 m on the low, sandy terrace on the north shore of the late glacial lake (Mathiassen 1937, 134-135). It has long been considered a single-component site, and the flint assemblage is often used as a reference assemblage for Maglemose culture late phase 0. The microlithic assemblage is dominated by simple, narrow, obliquely blunted lanceolates and a few segment microliths (Petersen 1967, 116-118). Of note, the assemblage contains quite a few core axes and irregular flake axes, which is rather unique since both artefact types are rare at the other Lake Bølling sites as well as on Mesolithic inland sites in Jutland generally. The microlith typology corresponds to late phase 0 (Petersen 1973), with a blade industry typical of the Maglemosian techno group 2 (Sørensen 2006, 62-

Site + sample no.	Lab.no.	Material	Context	C14-age BP	Cal BC (68,3 %)	Cal BC (95,4%)
2983x141c	AAR-33634	Charcoal (*Pinus sp.*)	Hearth X141	9547 +/- 52	9122-8760	9191-8740
2983x427	AAR-8341*	Charcoal (*Betula sp.*)	Hearth x141	9510 +/- 70	9121-8714	9154-8632
2983x141b	AAR-33633	Charcoal (*Salix sp.*)	Hearth X141	9405 +/- 55	8758-8618	9046-8490
2983x141a	AAR-33632	Charcoal (*Betula sp* .)	Hearth X141	9000 +/- 53	8289-8019	8296-7966
2983x797	AAR-9835	Charcoal (*Pinus sylvestris*)	Culture layer w/flint	8830 +/- 65	8172-7795	8230-7681
2983x101	AAR-9836	Charcoal (*Betula sp.*)	Hearth x99	8815 +/- 70	8169-7747	8218-7613

Table 2. Radiocarbon dates from the site Dværgebakke III. Calibrated in OxCal v.4.4 (Bronk Ramsey 2009) using the IntCal20 calibration curve (Reimer et al. 2020).
*This sample was originally published in Møbjerg and Rostholm 2006, table 1.

Site + sample no.	Lab.no.	Material	Context	C14-age BP	Cal BC (68,3 %)	Cal BC (95,4%)
Klosterlund	K-1317*	Charred wood (*Pinus sp.*)	Profile: Peat w/flint	9230 +/- 150	8631-8288	9120-8011
Klosterlund	K-1452*	Wood (*Pinus sp.*)	Profile: Peat w/flint	9200 +/- 140	8612-8286	9043-7968
Klosterlund	K-1316*	Wood (*Pinus sp.*)	Profile: Peat w/flint	9140 +/- 150	8612-8231	8780-7852
Klosterlund	K-1315*	Bark (*Pinus sp.*)	Profile: Peat w/flint	8920 +/- 140	8277-7836	8386-7601
2992x125	AAR-9426	Wood (*Salix sp.*), modified	Unit 104, peat w/flint	10150 +/- 75	9988-9672	10092-9404
2992x186	AAR-9427	Wood (*Pinus sp.*)	Unit 131, peat w/flint	8620 +/- 65	7716-7584	7932-7532
2992x175	AAR-8279*	Nutshell (*Corylus avellana*)	Test pit	8075 +/- 60	7174-6831	7311-6706

Table 3. Radiocarbon dates associated with the classic Klosterlund settlement. Calibrated in OxCal v.4.4 (Bronk Ramsey 2009) using the IntCal20 calibration curve (Reimer et al. 2020).
* Sample K-1315-1317 and K-1452 were originally published in Tauber 1971,130, and sample AAR-8279 in Møbjerg and Rostholm 2006, table 1.

63). The site was covered by peat and palynological analyses of stratigraphy and the cultural layer places the site in the Late Preboreal (Iversen 1937, 186). Just based on its large size the Klosterlund settlement stands apart from the other Maglemose sites in the area. During excavation the focus was on retrieving artefacts, and no hearths or dwelling structures were registered (Mathiassen 1937, 133). However, later studies of the distribution of the flint assemblage have suggested several concentrations of burnt flint, perhaps indicating the presence of hearths, along with possible discrete flint scatters. In light of the investigations of the other Early Mesolithic sites in the area, especially the Dværgebakke I settlements, it should be reconsidered if the Klosterlund settlement is indeed a single, one-event occupation or if it is rather made up of several smaller occupations/events during the Late Preboreal, which was also suggested by Petersen (2009, 115) and Sørensen *et al.* (2018, 317). Four conventional radiocarbon dates from the classic site have been made on wood/bark and charcoal in association with the cultural layer (Table 3: K-1315-17, K-1452). They are often cited but it is worth noting that they are conventional radiocarbon dates.

In association with the lake restoration project, test pits and two smaller excavation units were investigated in front of the classic site in the lake basin proper (Møbjerg and Rostholm 2006, 153; Møbjerg 2011,73-74). This yielded two separate horizons with worked flints, overall ascribed to the Early Maglemose period. Three samples from this area were radiocarbon dated, a piece of seemingly worked arctic willow from the lower horizon (Table 3: AAR-9426) and a piece of wood from the upper horizon (Table 3: AAR-9427). In one of the test pits a couple of charred pieces of wood were found alongside nutshells, some of which had toothmarks. One of these nutshells was also radiocarbon dated (Table 3: AAR-8279). Thus, there is dispersed traces of human activity on the bog surface in front of the Klosterlund settlement, just as over the years flints from the Maglemose and Ertebølle cultures have been collected from the field behind it (Andersen and Møbjerg 2009). Given the new investigations, the Klosterlund settlement may cover a much larger area and be more complex than previously thought.

Bølling Sø Vest IV

Located on a low, sandy rise in the lake basin immediately south of the western outlet, the Bølling Sø IV site is comprised of two thin cultural horizons separated by gyttja. The lower occupation dates to the Maglemose period and the upper one to the Ertebølle period (Møbjerg 2011, 74-75). The Maglemose horizon contained preserved wood, including an exceptional find of a wooden arrow with a groove at one end (Møbjerg 2008b, 16). On the northern part of the site, in or immediately adjacent to the stream, two sharpened poles were driven down into the subsoil. Perhaps remnants of a stationary fishing trap? One of these poles were radiocarbon dated (Table 4: AAR-9795). Southwest of the vertical poles, in an area covering approximately 5 x 10 m, several parallel pieces of worked wood up to 3.5 m in length were found lying horizontally. This feature is interpreted as a working platform on the bank of the stream (Møbjerg 2011, 74). A very small assemblage of 34 pieces of worked flint was found with the platform including a lanceolate microlith, a microblade core,

Site + sample no.	Lab.no.	Material	Context	C14-age BP	Cal BC (68,3 %)	Cal BC (95,4%)
4030x106	AAR-9846	Wood (*Pinus sylvestris*), horizo	Lower horizon	9540 +/- 60	9122-8771	9193-8656
3884x33	AAR-9795	Wood (Pinus sp.), vertical pole	Lower horizon	9280 +/- 60	8621-8429	8698-8306
4030x80	AAR-9796	Wood (*Pinus sp* .), horizontal	Lower horizon	8610 +/- 60	7715-7581	7780-7531
4030x64	AAR-9845	Charcoal (*Alnus sp.*)	Upper horizon	5249 +/- 47	4222-3984	4234-3970
4030x44	AAR-9844	Charcoal (*Betula sp.*)	Upper horizon	5183 +/- 48	4045-3956	4224-3806

Table 4. Radiocarbon dates from the site Bølling Sø Vest IV. Calibrated in OxCal v.4.4 (Bronk Ramsey 2009) using the IntCal20 calibration curve (Reimer et al. 2020).

and small blades characteristic of the Maglemose techno group 2 (Andersen 2010, 54). South of this feature, separated by a concentration of fist-sized stones, remnants of another possible platform were found. Two additional wood samples were radiocarbon dated (Table 4: AAR-9796 and AAR-9846). The upper cultural layer above the gyttja was only a few centimetres thick but contained a modest flint assemblage of 50 pieces of worked flint including transverse arrowheads, blade scrapers and larger blades that typologically date to the Ertebølle culture. Two charcoal samples from the upper horizon were radiocarbon dated (Table 4: AAR-9844 and AAR-9844). The gyttja layer between the two cultural horizons shows that the site was flooded between the early and the later occupations.

Dværgebakke VI

The Dværgebakke VI location holds an *in situ* stone pavement running from the late glacial terraces downslope towards the lake. Since this site was not due to be submerged, this feature was not fully excavated. The stones were located using an iron rod and could be followed for approximately 22m, however, the full extent was not determined (Møbjerg 2011, 72). Two small excavation units, placed at the southern and northern ends, were used to explore this feature. The stones, with a diameter of 15-30 cm, were carefully placed in a 50-70 cm wide band. In the southern unit a few worked flints, including a microlith fragment and two flakes from a microblade core typologically dating to the Maglemose period, were found between the stones. The pavement was set on peat, which slowly grew and eventually covered the structure. This indicates that the ground was relatively wet at the time of construction. The peat layers in which the pavement is situated are undisturbed and palynologically dated to the middle to late Boreal (Aaby 2006d, 5) which is in accordance with the small flint assemblage. So far, no other similar structures are known from this period. Although there are no radiocarbon dates from this locality, the pollen results demonstrate the spread of peat covering Maglemose sites already in the Boreal period.

Trædestensrækken

Trædestensrækken consist of a single row of stepping stones running for over 400 m from the late glacial terrace edge over the peat basin. In connection with these stones was a wooden construction which crossed the old stream. The row of stepping stones was palynologically dated to the transition from the Bronze Age to the Pre-Roman Iron Age while the wood is dendrochronologically dated to the Late Bronze Age (Møbjerg and Rostholm 2006, 148-150). Two thin, sandy cultural layers separated by gyttja were found near the wooden construction. The upper cultural layer contained polished flint flakes from the Neolithic. The lower layer had the remains of a small activity area with a few pieces of worked flint together with charcoal and burnt hazelnut shells. One nutshell was radiocarbon dated (Table 5: AAR-8147), dating the activity area to the Ertebølle period. Alongside two

Site + sample no.	Lab.no.	Material	Context	C14-age BP	Cal BC (68,3 %)	Cal BC (95,4%)
2878x183	AAR-8147*	Nutshell (*Corylus avellana*)	Lower horizon w/flint	6060 +/- 60	5044-4848	5208-4796

Table 5. Radiocarbon dates from the site Trædestensrækken. Calibrated in OxCal v.4.4 (Bronk Ramsey 2009) using the IntCal20 calibration curve (Reimer et al. 2020).
*This sample was originally published in Møbjerg and Rostholm 2006, table 1.

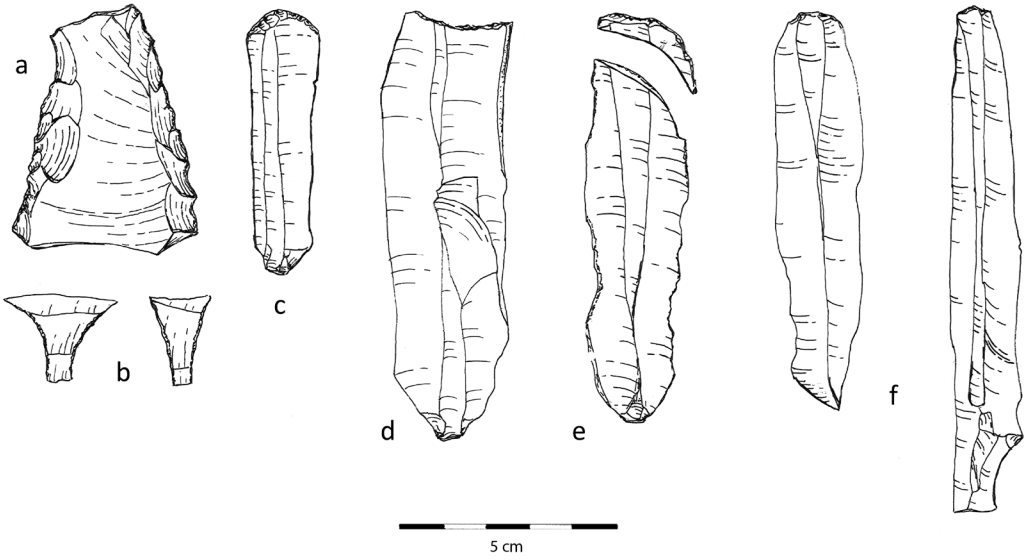

Figure 4. Examples of tools and blades from Bølling Sø Vest I. a) flake axe, b) transverse arrowheads, c) blade scraper, d) edge burin, e) transverse burin and burin spall, f) unmodified blades (Drawing: J.J. Kærgaard).

stray finds of transverse arrowheads it demonstrates activities on the peat surface alongside the stream during the Ertebølle period.

Bølling Sø Vest I

On the peat surface by the western outlet a stone-built feature was found. It consists of a connected row of hearths with fire-cracked stone and charcoal measuring circa 7 x 1.6 m surrounded by an outer ring of smaller stones measuring circa 11 x 6 m (Jensen and Møbjerg 2007). Approximately 900 pieces of worked flint were found throughout the feature, also in between the stones of the fireplaces, but surprisingly, few of these pieces are fire cracked. The lithic assemblage is dominated by blades and blade tools: knives, transverse burins and scrapers as well as transverse arrowheads and a flake axe (Figure 4). Additionally, there are more than 300 unmodified blades but remarkably few flakes. The tool assemblage seems uniform and specialised. Use-wear analysis of some burins and blades show work on meat, hide and bone/antler, though a few tools were also used on wood/plant material (Jensen and Møbjerg 2007, 56-58). This suggests a specialised activity with a focus on hunting and processing prey. The stone-built feature has no known contemporary analogue, but it is interpreted as a smoker – a tent built around a series of fireplaces where meat from the hunt could be smoked and preserved (Jensen and Møbjerg 2007). This locality is believed to result from a single event or episode. The lithic assemblage seems homogenous when it comes to raw material and technology. However, typologically the assemblage points in two directions: the transverse arrowheads and the flake axe are clear Ertebølle-types, while the relatively large blades/blade tools and curved, transverse burins are uncommon at the other known Ertebølle locations of Central Jutland. Interestingly, the blade scrapers and curved, transverse burins on large, regular blades looks very similar to those from the Dalhus site ascribed to the Kongemose period (Sindbæk 2006, 231). Five radiocarbon dates were obtained in relation to the feature and cultural layer. Three were taken as a sequence through the stone pavement, where one of them is from the layer with hearths itself (Table 6: AAR-9839), while two others are from layers that are stratigraphically older (Table 6: AAR-9840 and AAR-9841). In addition, two charcoal samples from the cultural layer were dated (Table 6: AAR-8342 and AAR-9842). The radiocarbon dates turned out slightly older than expected, if the flint assemblage indeed represents a single occupation from the Ertebølle culture. Pollen analyses of samples from the same profile places the cultural layer in the Atlantic period, most likely the younger part (Aaby 2005, 8; Jensen and Møbjerg 2007, 54). Moreover, pollen

Site + sample no.	Lab.no.	Material	Context	C14-age BP	Cal BC (68,3 %)	Cal BC (95,4%)
3883x583	AAR-9841	Charcoal (*Alnus sp .*)	Profile 315: layer 19 under structure	6965 +/- 55	5965-5769	5981-5731
3883x582	AAR-9840	Charcoal (*Corylus avellana*)	Profile 315: layer 18 under structure	6940 +/- 55	5883-5744	5978-5722
3883x581	AAR-9839	Charcoal (*Corylus avellana*)	Profile 315: layer 17 with structure	6540 +/- 50	5606-5420	5617-5379
3883x635	AAR-9842	Charcoal (*Alnus sp.*)	Layer 17 with structure	6959 +/- 49	5892-5765	5978-5732
3883x36	AAR-8342*	Charcoal (*Corylus avellana*)	Layer 17 with structure	6865 +/- 45	5799-5673	5877-5658

Table 6. Radiocarbon dates from the site Bølling Sø Vest I. Calibrated in OxCal v.4.4 (Bronk Ramsey 2009) using the IntCal20 calibration curve (Reimer et al. 2020).
*This sample was originally published in Møbjerg and Rostholm 2006, table 1.

analyses suggest that the ground would have been wet during the cold parts of the year, thus making the site uninhabitable during winter.

Summary of Mesolithic settlement in the western end of Lake Bølling

The large number of well-preserved Mesolithic sites in the western part of the Lake Bølling area is remarkable and especially important when flint analyses can be combined with radiocarbon dates and palynological analyses. However, most of the newfound sites (not presented here) appeared as flint scatters where we have to rely on flint analyses alone. But a clear pattern emerges. Sites are either attributable to the Early Maglemose, phases 0-2 exclusively (Andersen 2010, 76), or the Ertebølle culture. There are only very few traces of the intermediate Kongemose culture which is in accordance with the pollen diagrams, where human influence can no longer be detected from the onset of the Early Atlantic (Aaby 2006c, 12). The Early Mesolithic Maglemose sites are by far the most numerous. In general, these sites are relatively small, at most a few meters in diameter, and consist of small assemblages of worked flints. They appear to be the result of short-lived but recurrent occupations. Only two sites can be considered large, Dværgebakke I and the Klosterlund settlement. But Dværgebakke I is clearly a palimpsest, and it is suggested that the Klosterlund settlement should be considered the same. The Early Mesolithic settlements are located on the sandy, low, late-glacial terraces on the lakeshore and on the peat surface in the lake basin proper, when open water is replaced by peat growth. When the lake basin is covered by peat in the Late Boreal/Early Atlantic, settlement seems to disappear. It is not until the Ertebølle period that actual settlements reappear in the western end of the Lake Bølling area. However, the sites have a slightly different character and appear in different parts of the landscape than during the Early Mesolithic. On the peat surface that developed along the western outlet of the lake, there are traces of various activities from the Ertebølle period but they seem to be of a more specialised nature. Settlements with diverse tool kits are now found on the edges of the high plateaus around the lake basin with good views over the valley (Møbjerg and Rostholm 2006, 152). Thus, there seems to be a marked change in settlement patterns from the Early to the Late Mesolithic, not least of which is a settlement hiatus in the 7th millennium BC, corresponding to the Early Atlantic period (Figure 5). This is supported by flint and pollen analyses along with radiocarbon dates.

Perspectives on bog settlement

The changes in settlement in the western part of the Lake Bølling area when open water is replaced by the growth of peat is not just a local phenomenon, but something also seen in the large bog basins in other parts of Denmark, *e.g.*, in the large Køng-Lundby-Sværdborg bog complex on southern Zealand, where the Early Maglemose occupations are found on the western shore of the late glacial lake whereas the Late Maglemose occupations are found on the peat surface in the eastern part, seemingly moving out on the peat surface to follow open waters (Johansson 2006, 124). Many barbed bone points (linked to spearfishing), found throughout the bogs of Southern Scandinavia, especially on Zealand and in Scania, point to these wetlands as significant fishing grounds, possibly a main attraction for settlement. Early fine-barbed

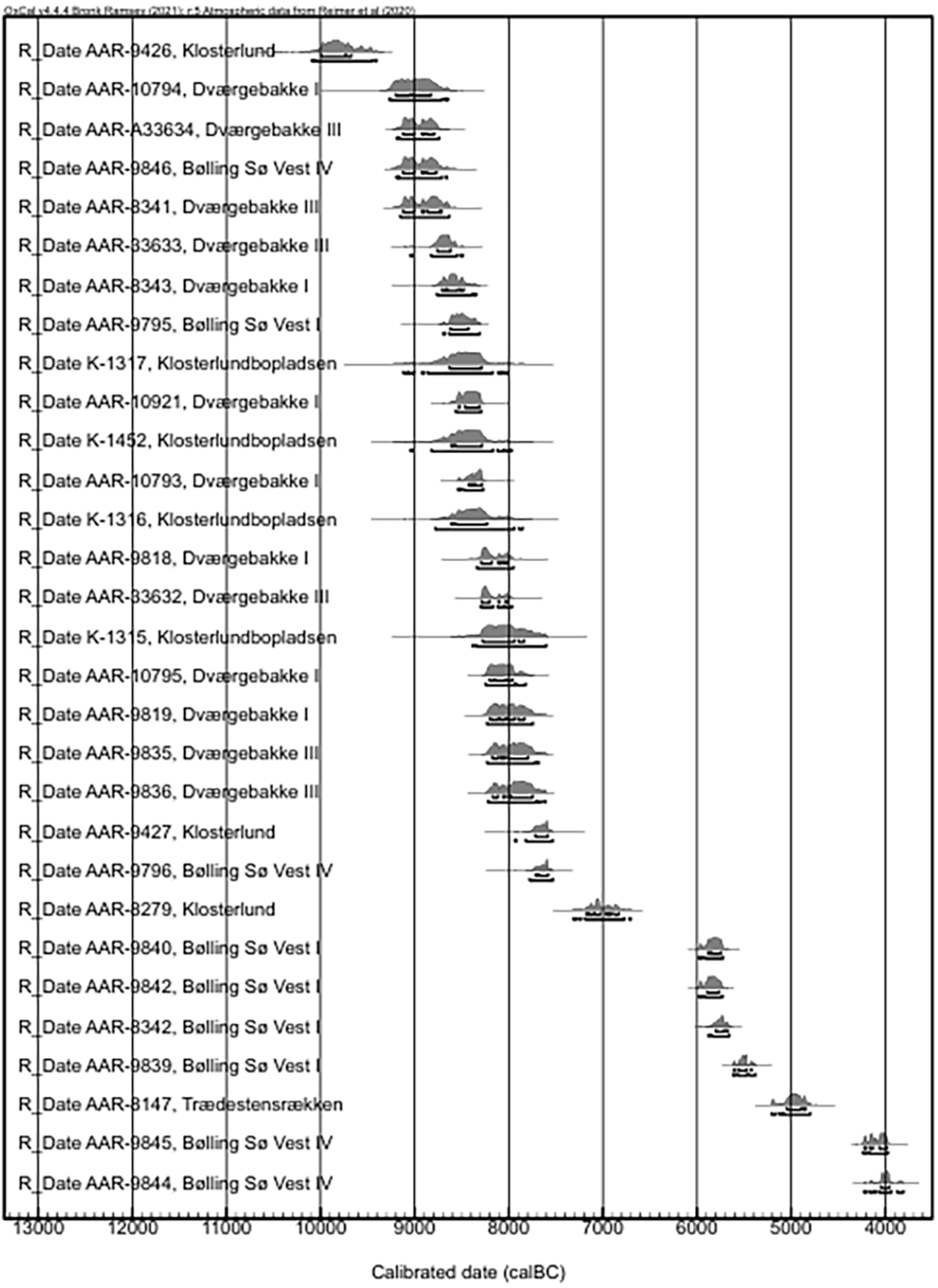

Figure 5. Unmodeled plot of all radiocarbon dates from the Mesolithic Lake Bølling-sites. Noteworthy is the lack of dates from the 7th millennium BC corresponding to a general lack of sites from this period in the western part of the lake basin.

types and later large-barbed bone point types reflect activities, if not settlement, during the Maglemose period. A recent study has demonstrated a noticeable hiatus of approximately 600 years between the early and the late bone point types, the onset of which is around 10,300 calBP (Jensen *et al.* 2020). This suggests a change in the use of the bogs and perhaps settlement more generally. Interestingly, this hiatus is contemporary with a general change in flint technology, from Early Maglemosian percussion knapping to Late Maglemosian pressure flaking, two very different technological traditions (Sørensen 2012, 239-242). The Maglemose localities in the western end of Lake Bølling can be attributed typologically to the Early Maglemosian phases 0-2 and technologically to techno-group 2, characterised by percussion knapping, whereas traces of Late Maglemosian and Kongemose occupation is sparse and the pressure flaking technique completely absent. The area was recurringly inhabited during the Preboreal and Boreal followed by an occupation hiatus in the Early Atlantic. This break in occupation falls in the 7th millennium BC and thus, later than the hiatus demonstrated between the early and the late bone point types. The onset of the pause in occupation at Lake Bølling seems to correlate to the spread of peat in the lake basin at the expense of open water, thus supporting the hypothesis that changes in settlement are somehow related to changes in the nature of the landscape. But the fluctuation in Mesolithic occupation intensity at Lake Bølling also seem to reflect a larger trend with fewer inland sites from especially the Kongemose and Early Ertebølle periods in general (Fischer 1993, 59). For example, the Holmegårds Bog on southern Zealand holds numerous occupations from the Maglemose period followed by a marked drop in the number of sites from the Kongemose and Early Ertebølle periods, with a final occupation peak from the Middle Ertebølle and into the Early Neolithic (Schilling 2003, 352-353). A similar pattern is seen in the Neverkær Bog basin on Funen, where Maglemose as well as Ertebølle sites are found but not Kongemose locations (Jensen 2001, 102-103). The Lake Bølling investigations demonstrate two Mesolithic occupation phases, an Early Mesolithic Maglemose phase and a Late Mesolithic Ertebølle phase. Thus, the changes in the Mesolithic settlement at Lake Bølling seem to follow a more general trend. The question is whether the conclusions from the Lake Bølling investigations and changes in the bog settlement can be used to further elucidate the inland Mesolithic settlement in Central Jutland in general, where the landscapes and biotopes are different? Museum Midtjylland has investigated this question for many years through excavation of Mesolithic sites, and it seems like the tendencies could be valid outside of bog contexts. Something happens with settlement pattern, intensity and use of landscape in the Early Atlantic period.

The inland Mesolithic of Central Jutland – general observations

Maglemose settlement

There are only few traces of (Late) Palaeolithic occupation in the area covered by Museum Midtjylland. So far, we know only two regular settlements, Dværgebakke I at Lake Bølling (presented in this paper) and Trindtoft (unpublished), from respectively the Ahrensburgian and Epi-Ahrensburgian, along with a few single finds and small flint assemblages that point towards the Late Palaeolithic. This might suggest sporadic settlement, as would be expected in a pioneer phase. On the other hand, Early Mesolithic sites are numerous. The majority of Mesolithic sites discovered in recent decades belong to the Early Maglemose period (phases 1-2), which points to an established but mobile settlement tied to the inland streams and lakes, at least from the middle of the Preboreal and Boreal. Very few sites with assemblages ascribed to the Late Maglemose (phases 3-5) have been found. Interestingly, these small assemblages show no evidence of pressure blade technology. At the Skovby-site it has been demonstrated that the characteristic and diagnostic projectile points, long, slender trapezes and asymmetrical triangular microliths, are made from small blades produced by direct percussion from small, prismatic cores (Khan 2023, 25-26) – technically characteristic for the Maglemose techno-group 2 (Sørensen 2006, 62). That these microliths are indeed produced this way has been demonstrated through raw material

analysis and refitting. Even if we only know of a few single component sites from the Late Maglemose period in Central Jutland, the diagnostic microliths are sometimes found in the mixed assemblages (*e.g.* Mathiassen 1937; Rostholm 1982, 12) demonstrating that the area was not void of habitation during this period. M. Sørensen has investigated some of these mixed assemblages with microliths characteristic for the Late Maglemose looking for evidence for conical cores and pressure blade technology in Jutland without success and suggests a different development in blade production than in the eastern parts of Southern Scandinavia (Sørensen 2018, 189-192). This is very much in accordance with the evidence found by Museum Midtjylland. This suggests that the technological tradition of percussion flaking continues throughout the Maglemose period, which is markedly different from the pressure blade technique adopted in eastern Denmark. Studies of the spread of the pressure blade concept suggest that it reached eastern Denmark from the north through the Scandinavian peninsula (Sørensen 2018, 197). However, it does not seem to have reached western Denmark (Jutland) or northern Germany, although also present in the Baltic Sea area (Sørensen *et al.* 2013, 44). Thus, there seems to be a notable difference between east and west, where microlith typology follows a similar development but blade technologies differ. Sørensen hypothesises that this implies regionalised social organisation with only sporadic social contact between different regions (Sørensen 2018, 177).

Kongemose settlement

The issues we encounter with the Late Maglemose sites and assemblages seem to hold true for the Kongemose occupation as well. The diagnostic oblique/rhombic arrowheads are sometimes found in the mixed Mesolithic assemblages of Central Jutland, but we are yet to find an undisturbed Kongemose settlement. Thus, we do not have a good grasp of what a single component Kongemose flint assemblage looks like. Investigations of the Dalhus locality on the Storå east of Holstebro is, for the time being, still the best example of an inland Kongemose assemblage in Jutland (Sindbæk 2006). The flint assemblage shares similarities with the classic Kongemose assemblages from Zealand (Sørensen 2017, 35-54), including rhombic points, various blade tools, and larger blades made by indirect percussion but there also seem to be notable differences in the various tool types and their frequencies, as well as how they are produced (Sindbæk 2006, 235). The assemblage is adapted to the locally available raw material, moraine flint nodules, yielding smaller blades and blade tools, moreover there is a general lack of core tools. Only two axe fragments and a small, pointed core tool were found at Dalhus (Sindbæk 2006, 228). Few or no axes seems to be a recurring theme at inland sites throughout the Mesolithic in general (as already noted by Mathiassen in 1937, 78-81 and Andersen 1995, 24), with Klosterlund and a few other mixed sites as notable exceptions (Mathiassen 1937, 10-35, 136-139). The Dalhus assemblage also lacks evidence for actual microblade production as well as handle-cores. In a study of the inland Mesolithic in the Holstebro area, which borders the study area to the northwest, Sindbæk reports, that Kongemose material appears in 25% of the dateable Mesolithic flint assemblages (Sindbæk 2001, 110). Based on archive studies at Museum Midtjylland, the number seems to be equivalent in our study area. Thus, traces of Kongemose occupations appear rather numerous, but we need a better grasp of what characterises a single component assemblage. Rhombic points and pointed core tools are still the most diagnostic indicators for occupation from this period. Moreover, the Dalhus assemblage suggest that we should expect a regional (inland) signature with tool production adapted to the locally available raw material. However, one key element that seems to be missing is the handle-core.

The handle-core conundrum

In general, the classic handle-cores, which are otherwise diagnostic for the Kongemose assemblages on Zealand (Petersen 1984, 10-11; Sørensen 2017, 44) and Northern Germany (Söderlin 2018; Hartz 2009) are rare in inland Jutland (Ballin 2016, 167). Not even in the mixed assemblages with rhombic points are these cores generally found (Andersen and Sterum 1979, 27; Sørensen 2018, 192).

Although Ballin (2016), meticulously sifting through older publications, manages to find a few located on the Gudenå and the Vejle Å (Ballin 2016, 166), they are still extremely rare if not completely absent on the inland, and are yet to be recognised in our study area. The presence of classic handle-cores in the Limfjord-region of Northern Jutland (Ballin 2016), as well as in Schleswig-Holstein to the south, where they are common in the assemblages from the Late Maglemose/Kongemose periods (Hartz 2009, 406; Söderlind 2024, 19), makes the absence of classic handle-cores in Central Jutland even more striking. Ballin suggest, that it could be related to raw material availability (Ballin 2016, 167), since the locally available raw material on the old moraine of Central and Western Jutland, are relatively small flint nodules and frost shattered pieces. In the study by Ballin (2016) Sindbæk reports that, through refitting, the very small core fragments from Dalhus could grow surprisingly large demonstrating, that the cores were completely exhausted when discarded (Ballin 2016, 167), thus making the most out of the available raw material. In our study area we have noticed an interesting change in the operational schema associated with microblade production from the small moraine nodules in the some of the few flint assemblages ascribed to the Late Maglemose period. The front of the core, from which series of microblades are detached, are sometimes shifted from the broad side of the nodule to the narrow side of the nodule. This makes the core front very narrow, often with only one or a few parallel detachment scars, but the platform and core itself elongated (Figure 6). This demonstrates a microblade production adapted to the local flint, in order to make the most microblades out of the often very small and flat nodules. The narrow front and elongated platforms of these cores bear vague reminiscence of the handle-core concept. So far, we have only observed this operational schema in assemblages with slender, triangular microliths and trapezes. The lack of single component sites from the Kongemose period makes it impossible to determine whether this operational schema for microblade production continues. The absence of classic handle-cores (and large blade-cores and blades in general) in the study area suggest a regional signature for the Kongemose assemblages adapted to the local flint. Great caution should be taken when making conclusions based on the absence of an artefact type, the classic handle-core, but close to 100 years of research interest into the flint assemblages of Central Jutland has failed to produce them.

Ertebølle settlement

Whereas occupations from the Late Maglemose and Kongemose cultures are difficult to locate and recognise, Ertebølle sites are more numerous (*e.g.* Møbjerg 2011, 59). In addition to the Lake Bølling investigations, the large highway projects around Herning in recent decades have yielded sites, as did other salvage archaeology projects (*e.g.* Møbjerg 2006, Møbjerg 2008a, Møbjerg 2011). Yet, we do not have a good grasp of inland Ertebølle settlement. One of the problems is that these sites are extremely difficult to date more precisely based on flint analyses and artefact typology alone. Also, we lack the diagnostic artefacts of organic materials that could otherwise help to place the sites and thereby flint assemblages in the relative chronology more precisely (*e.g.* Petersen 1984, 13-15). On some sites a few pot sherds are found, placing these localities in the Late Ertebølle period, but ceramics, which are quite diagnostic for the Late Mesolithic (Petersen 1984, 11-12), are few on the inland sites. Again, the flint assemblages are often the only way to get a relative date for these sites, but we still lack comprehensive analyses of the flint assemblages from many of these localities. However, a recent study of Late Ertebølle inland sites in Schleswig-Holstein included four assemblages from Central Jutland (Meyer 2020, 163). This study suggests that the inland Ertebølle assemblages in Central Jutland (and Schleswig-Holstein) are different from coastal settlements in several ways. The sites are smaller than the coastal ones and the tool kits less diverse (as also noted by Andersen 1998, 24). The formal tools are generally smaller and adapted to the locally available raw material. Axes, which usually are numerous on coastal sites, are rare, just as ceramic finds are generally limited to just a few sherds (Meyer 2020, 175). Meyer concludes, that the inland assemblages mainly consist of tool types present in all phases of the Ertebølle period which makes typological dating

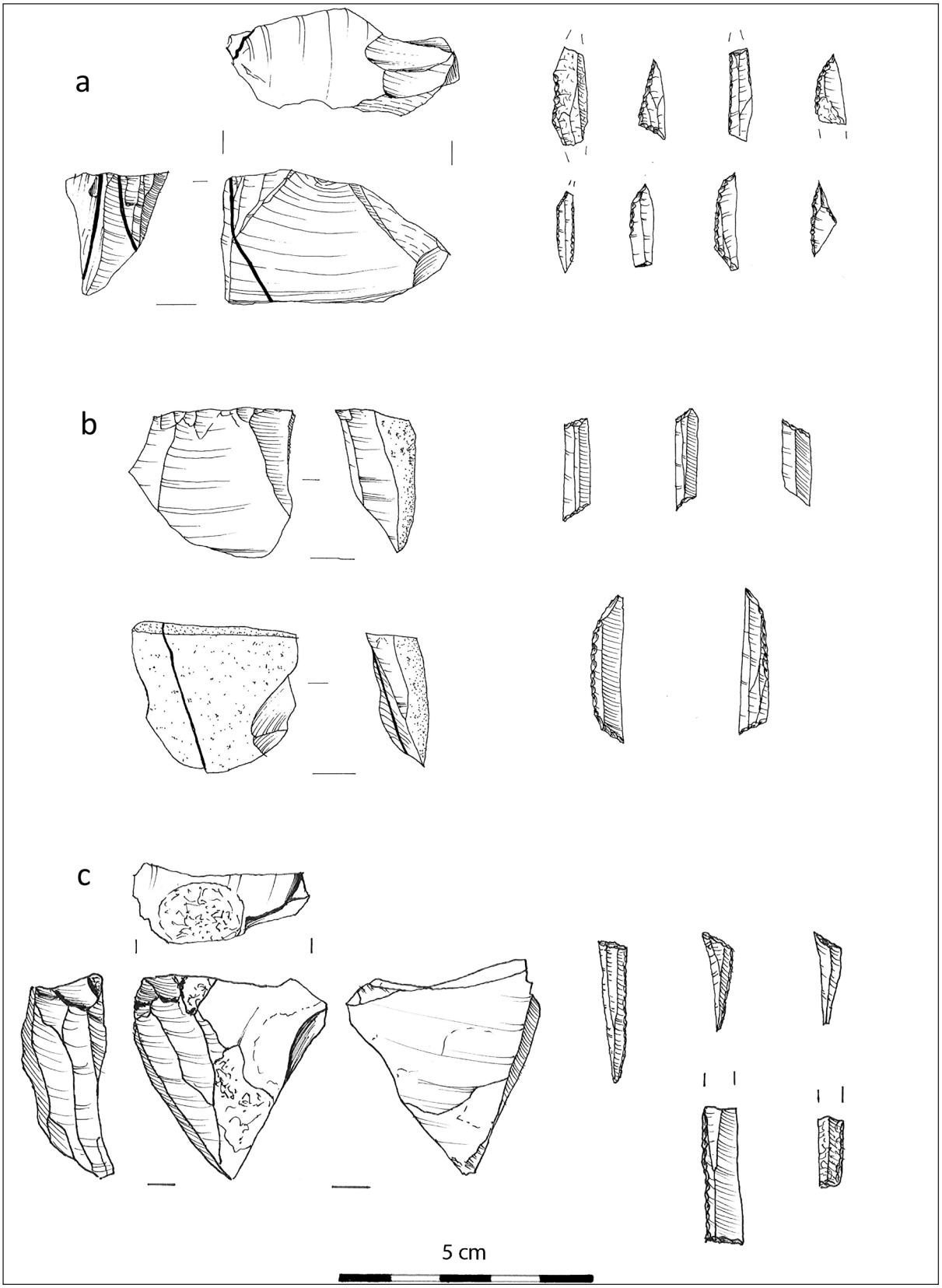

Figure 6. Examples of microblade cores and microliths from three assemblages with Late Maglemose components: a) Kærgård (HEM 2917), b) Skovby Nordvest (HEM 3317), c) Europavej (HEM 5358) (Drawing: S.T.M. Christensen).

difficult (Meyer 2020, 173). So far, the conclusion must be that the inland Ertebølle flint assemblages have a different expression than the coastal ones, which are numerous and well-established along the fjords of the east coast of Jutland (*e.g.* Andersen 1993, 1995, 2000). Further studies are greatly need-

ed to elucidate the temporal development and diagnostics of the flint assemblages, as well as settlement pattern and intensity of the inland Ertebølle settlement.

Towards a more regionalised Danish Mesolithic

The Lake Bølling project and other Mesolithic excavations in Central Jutland suggest that settlement patterns and intensity change throughout the very long time span of the Mesolithic, although we still do not have a good grasp of how and why. In Central Jutland sites from the Early Maglemose period as well as the Ertebølle period are numerous, whereas sites from the Late Maglemose and Kongemose period are harder to locate and recognise. That inland Jutland was not void of habitation during the early Atlantic period is mainly recognised through the presence of diagnostic projectile points in the mixed assemblages. The question is if the scarcity of single event sites from this period represents a research lacuna or rather reflects an actual change in settlement pattern and/or a drop in settlement intensity? The results from the Lake Bølling project suggest the latter which seem to be a part of a larger trend. The settlement pattern changes from the onset of the Early Atlantic period, where the Littorina transgressions make islands out of eastern Denmark and the North Sea basin is inundated effectively shaping the Jutland peninsula (Christensen 1993, 1995). Whereas the flint assemblages from the Early Maglemose period typologically and technologically follow the same development as in the eastern parts of Denmark the assemblages from the Late Maglemose period appear to have a different technological signature adapted to the locally available raw material, a regionality which seem to hold true for Kongemose period as well. This testifies to a population with intimate knowledge of the local resources, who did not travel to more flint rich areas on a regular basis suggesting a social territory on the inland. For the Ertebølle period social territories have been suggested for the fjords of east Jutland (Andersen 1995, 45-48, 1998, 24, fig. 3), where sites and shell middens are numerous. It has been suggested that the inland Ertebølle sites on the Jutland rivers and waterways merely represent a different use of landscape; hinterland resource grounds for a coastal population, visited as part of a seasonal round (Andersen 1998, 55). Direct contact between inland and coast is hard to prove when organics such as animal (and human) bones are not preserved at the Central Jutland sites. Coastal flint does not seem to have made its way to the Ertebølle sites of Central Jutland, where tools are produced from the local moraine flints. Scarcity of e.g. pottery and flint axes, common on coastal sites, could explained by different activities performed on the inland if not by different populations and social territories. In order to move forward and better understand the inland Mesolithic in Jutland – and further examine regionalisation and social territories – requires both landscape analyses including already known sites as well as more single component sites providing firm characteristics for the flint assemblages, both typologically and technologically, as a tool for relative dating. Of course, the dream scenario is sites that are also absolutely dated. Therefore, it is important to prioritise radiocarbon dating (and other natural science analyses) when new sites are discovered and excavated. However, we must acknowledge that this is not possible for all sites. Flint assemblages will remain the most important source material for the inland sites, making flint analyses the key to understand the inland Mesolithic.

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References

Aaby, B., 2005. *Pollenanalytiske undersøgelser i Bølling Mose i forbindelse med Herning Museums arkæologiske udgravninger 2003*. Museum Midtjylland.

Aaby, B., 2006a. Landskab og vegetation omkring Bølling Sø siden sidste istid. *In*: B.V. Eriksen, ed. *Stenalderstudier. Tidligt mesolitiske jægere og samlere i Sydskandinavien*, Jysk Arkæologisk Selskabs Skrifter 55. Højbjerg: Jysk Arkæologisk Selskab, 161-174.

Aaby, B., 2006b. *Pollenanalytiske og vegetationshistoriske undersøgelser i forbindelse med arkæologisk udgravning af boplads HEM 2981 ved Bølling Sø i 2005*. Museum Midtjylland.

Aaby, B., 2006c. *Pollenanalytiske og vegetationshistoriske undersøgelser i forbindelse med arkæologisk udgravning af boplads HEM 2981 ved Bølling Sø i 2006*. Museum Midtjylland.

Aaby, B., 2006d. *HEM 3885. Pollenanalytiske undersøgelser af polleprøver fra profil gennem stenlægning*. Museum Midtjylland.

Andersen, L.R., 2007. Gammelbosig II. En lille jagtstation fra maglemosekulturen. *Museum Midtjylland. Midtjyske Fortællinger* 2007, 45-50.

Andersen, L.R., 2008. En ny redskabstype fra maglemosekulturen. Sammensætning af kvartsit fra Dværgebakke I. *Museum Midtjylland. Midtjyske Fortællinger* 2008, 77-84.

Andersen, L.R., 2010. *Maglemosekultur ved Bølling Sø i Midtjylland. En samlet fremstilling og analyse af alle kendte Maglemosepladser i den vestlige del af Bølling Sø området med henblik på at belyse bosættelsen i et synkront og diakront perspektiv*. Unpublished master's thesis. Aarhus University.

Andersen, L.R. and Møbjerg, T., 2009. Arkæologi og muldvarpeskud – nye undersøgelser ved Bølling Sø. *Museum Midtjylland. Midtjyske Fortællinger* 2009, 37-44.

Andersen, S.H., 1993. Kystens bopladser. *In*: S. Hvass and B. Storgaard, eds. *Da Klinger i muld…25 års arkæologi i Danmark*. Det Kgl. Nordiske Oldskriftsselskab and Jysk Arkæologisk Selskab, 65-69.

Andersen, S.H., 1995. Coastal adaptation and marine exploitation in Late Mesolithic Denmark – with special emphasis on the Limfjord region. *In*: A. Fischer, ed. *Man and Sea in the Mesolithic. Coastal settlement above and below present sea level*. Oxbow Monographs 53, Oxford: Oxbow books, 41-66.

Andersen, S.H., 1998. Ringkloster. Ertebølle trappers and wild boar hunters in eastern Jutland. A survey. *Journal of Danish Archaeology* vol. 12, 1994-1995, 13-59.

Andersen, S.H., 2000. 'Køkkenmøddinger' (Shell Middens) in Denmark: a survey. *Proceedings of the Prehistoric Society,* Vol.66, 361-384.

Andersen, S.H., Sterum, N., 1971. Gudenåkulturen. *Holstebro Museum, Årsskrift* 1970-71, 14-32.

Ballin, T.B., 2016. Handle-Cores from Northern Jutland and Regionality in the Danish Mesolithic – Is the Assumed East-West Split as Clear-Cut as Generally Perceived? *Quartär,* 63, 157-168.

Bronk Ramsey, C., 2009. Bayesian analyses of radiocarbon dates. *Radiocarbon,* 51 (1), 337-360.

Christensen, C., 1993. Land og hav. *In*: S. Hvass, B. Storgaard, eds. *Da Klinger i muld…25 års arkæologi i Danmark*. København: Det Kgl. Nordiske Oldskriftsselskab, 20-27.

Christensen, C., 1995. The Littorina transgressions in Denmark *In*: A. Fischer, ed. *Man and Sea in the Mesolithic: Coastal Settlement Above and Below Present Sea Level*. Oxbow Monographs 53, 15-22.

Christensen, N.M.L, 2021. *14C dating as a tool for pinpointing the Palaeolithic/Mesolithic transition and the colonisation of southern Scandinavia. A case study from Dværgebakke III at Bølling Lake*. Unpublished master's thesis. Aarhus University.

Christensen, S.T., 2008. Slidsporsanalyser af flint fra Dværgebakke I. En undersøgelse af skrabere fra en ahrensburg/maglemoseplads i Midtjylland. *Museum Midtjylland. Midtjyske Fortællinger* 2008, 65-76.

Christensen, S.T.M., 2017. The Mesolithic inland settlement of Jutland. *In*: M. Sørensen, K.B. Pedersen, eds. *Problems in Palaeolithic and Mesolithic Research*. Arkæologiske studier, Volume 12. Copenhagen: The Saxo Institute, 151-159.

Fischer, A., 1993. Mesolitisk indlandsbosættelse. *In*: S. Hvass, S., B. Storgaard, eds. *Da klinger i Muld...25 årsarkæologi i Danmark*. København: Det Kgl. Nordiske Oldskriftsselskab, 58-64.

Iversen, J., 1937. Appendix. Pollenanalytiske Tidsbestemmelser af Midtjydske Mesolitiske Bopladser. *Aarbøger for Nordisk Oldkyndighed og Historie* 1937, 182-186.

Hartz, S., 2009. Towards a new chronology of the late Mesolithic in Schleswig-Holstein. *In*: P. Crombé, M.V. Strydonck, J. Sergant, M. Boudin, M. Bats, eds. *Chronology and evolution within the Mesolithic of North-West Europe. Proceedings og an International Meeting, Brussels, May 30th-June 1st* 2007. Cambridge Scholars Publishing, Newcastle, 395-417.

Jensen, L.E., 2001. Maglemosekultur på Fyn. *In*: O.L. Jensen, S.A. Sørensen, K.M. Hansen, eds. *Danmarks jægerstenalder – status og perspektiver. Beretning fra symposiet "Status og perspektiver indenfor dansk mesolitikum" afholdt i Vordingborg, september 1998*. Hørsholm: Hørsholms Egns Museum, 101-108.

Jensen, H.J. and T. Møbjerg, 2007. Et røgeri fra ældre stenalder ved Bølling Sø. *Museum Midtjylland. Midtjyske Fortællinger* 2007, 51-62.

Jensen, T.Z.T., Sjöström, A., Fischer, A., Rosengren, E., Lanigan, L.T., Bennike, O., Richter, K.K., Gron, K.J., Mackie, M., Mortensen, M.F., Sørensen, L., Chivall, D., Iversen, K.H., Taurozzi, A.J., Olsen, J., Schroeder, H., Milner, N., Sørensen, M., Collins, M., 2020. An integrated analysis of Maglemose bone points reframes the Early Mesolithic of Southern Scandinavia. *Scientific Reports*, 10, Article 17244. https://doi.org/10.1038/s41598-020-74258-8

Johansson, A.D., 2006. Maglemosekulturens fiskepladser i Køng Mose og Barmose, Sydsjælland. *In*: B.V. Eriksen, ed. *Stenalderstudier. Tidligt mesolitiske jægere og samlere i Sydskandinavien*. Højbjerg: Jysk Arkæologisk Selskab, 119-134.

Khan, D.S., 2023. Kærgård og Skovby. Maglemosekulturens regionale flinttraditioner. *KUML* 2023 *Årbog for Jysk Arkæologisk Selskab,* 9-39.

Mathiassen, Th., 1937. Gudenaa-kulturen. En Mesolitisk Indlandsbebyggelse I Jylland. *Aarbøger for Nordisk Oldkyndighed og Historie* 1937, 1-181.

Mathiassen, Th., 1948. *Studier over Vestjyllands Oldtidsbebyggelse.* Nationalmuseets Skrifter, Arkæologisk-Historisk Række, II. København.

Meyer, A., 2020. Inland and West coast Ertebølle culture in Schleswig-Holstein: A Survey. *In*: A. Zander and B. Gehlen, eds. *From the Early Preboreal to the Subboreal period – Current Mesolithic research in Europe. Studies in honour of Bernhard Gramsch.* Kerpen-Loogh: Welt und Erde Verlag, 161-178.

Møbjerg, T., 2005. Dværgebakke. En boplads ved Bølling Sø med fund fra ahrensburg- og maglemosekultur. *Museum Midtjylland. Midtjyske Fortællinger* 2005, 12-16.

Møbjerg, T., 2006. Overgård. En boplads fra sidste del af ertebøllekulturen. *Museum Midtjylland. Midtjyske Fortællinger* 2006, 21-26.

Møbjerg, T., 2008a. Nye bopladsfund fra Brande. *Museum Midtjylland. Midtjyske Fortællinger* 2008, 85-102.

Møbjerg, T., 2008b. Arkæologiske undersøgelser ved Bølling Sø. Samspillet mellem natur og kultur gennem mere end 10.000 år. *In*: F. Boysen, N.P. Brøgger, B. Daugaard, Å. Ebbesen, eds. *Bølling Sø og Stenholt Skov – Historie og Natur.* Viborg: Boelund Forlag, 11-21.

Møbjerg, T., 2011. Ældre stenalder – en glemt periode i dansk arkæologi. *Museum Midtjylland. Midtjyske Fortællinger* 2011, 57-80.

Møbjerg, T., Christensen, S.T., 2006. Dværgebakke. Spor af 3.000 års bosættelse fra ahrensburg- og maglemosekultur ved Bølling Sø. *Museum Midtjylland. Midtjyske Fortællinger* 2006, 13-20.

Møbjerg, T., Rostholm, H., 2006. Foreløbige resultater af de arkæologiske undersøgelser ved Bølling Sø. *In*: B.V. Eriksen, ed. *Stenalderstudier. Tidligt mesolitiske jægere og samlere i Sydskandinavien.* Jysk Arkæologisk Selskabs Skrifter 55. Højbjerg: Jysk Arkæologisk Selskab, 147-159.

Petersen, E.B., 1967. Klosterlund – Sønder Hadsund – Bøllund: Les trois sites principaux du Maglemosien ancient en Jutland: Essai de typologie et de chronologie. *Acta Archaeologica* 37, 77-180.

Petersen, E.B., 1973. A survey of the Late Palaeolithic and Mesolithic of Denmark. *In*: S.K. Kozłowski, ed. *The Mesolithic in Europe*, 77-127. Warsaw: Warsaw University Press.

Petersen, E.B., 2009. The human settlement of Southern Scandinavia 12500–8700 cal BC. *In*: M. Street, N. Barton, T. Terberger, eds. *Humans, environment and chronology of the north European Plain. Proceeding of Workshop 14. Commission XXXII, The final Palaeolithic of the Great European Plain of the 15th UISPP Congress, Lisbon, September* 2006. Mainz: RGZM, Band 6, 89-131.

Petersen, P.V., 1984. Chronological and Regional Variation in the Late Mesolithic of Eastern Denmark. *Journal of Danish Archaeology* 3, 7-18.

Reimer, P., Austin, W., Bard, E., Bayliss, A., Blackwell, P., Bronk Ramsey, C., Butzin, M., Cheng, H., Edwards, R., Friedrich, M., Grootes, P., Guilderson, T., Hajdas, I., Heaton, T., Hogg, A., Hughen, K., Kromer, B., Manning, S., Muscheler, R., Palmer, J., Pearson, C., van der Plicht, J., Reimer, R., Richards, D., Scott, E., Southon, J., Turney, C., Wacker, L., Adolphi, F., Büntgen, U., Capano, M., Fahrni, S., Fogtmann-Schulz, A., Friedrich, R., Köhler, P., Kudsk, S., Miyake, F., Olsen, J., Reinig, F., Sakamoto, M., Sookdeo, A., Talamo, S., 2020. The IntCal20 Northern Hemisphere radiocarbon age calibration curve (0–55 cal kBP). *Radiocarbon, 62*, 725-757. https://doi.org/10.1017/RDC.2020.41

Rostholm, H., 1982. *Oldtiden på Herning-egnen. Spor efter mennesker gennem 8000 år.* Herning.

Rostholm, H., 2001. Bølling Sø – et såkaldt naturgenopretningsprojekt. *FRAM. Fra Ringkøbing Amts Museer* – 2001, 68-86.

Rysgaard, K., Rasmussen, K.F., Riede, F., 2016. Mesolitiske bosættelser ved Gudenåsystemets søer og åer. *KUML* 2016 *Årbog for Jysk Arkæologisk Selskab,* 55-80.

Schilling, H., 2003. Early Mesolithic settlement patterns in Holmegårds Bog on South Zealand, Denmark. A Social Perspective. *In*: H. Kindgren, K. Knutsson, D. Loeffler, A. Åkerlund, eds. *Mesolithic on the Move. Papers presented at the Sixth Internationel Conference on the Mesolithic in Europe, Stockholm 2000*. Oxford, 351-358.

Sindbæk, S.M. 2001. Hvad blev der af Gudenåkulturen? Om Holstebro Museums mesolitiske projekt. *In*: O.L. Jensen, S.A. Sørensen, K.M. Hansen, eds. *Danmarks jægerstenalder – status og perspektiver. Beretning fra symposiet "Status og perspektiver inden for dansk mesolitikum" afholdt i Vordingborg, september 1998*. Hørsholm Egns Museum, 109-114.

Sindbæk, S.M 2006. Dalhus. En Kongemoseplads ved Storåen og spørgsmålet om den mesolitiske indlandsbebyggelse i Jylland. *In*: B.V. Eriksen, ed. *Stenalderstudier. Tidligt mesolitiske jægere og samlere i Sydskandinavien.* Jysk Arkæologisk Selskabs Skrifter 55. Højbjerg: Jysk Arkæologisk Selskab, 213-239.

Söderlind, S., 2018. A Study of the Mesolithic Handle Core Technology in Schleswig Holstein. *Archäologische Informationen*, 41, 305-316.

Söderlind, S. 2024. *The Handle Core Concept. Lithic Technology and Knowledge Transmission in Mesolithic Northern Europe.* ROOTS Studies, Vol.6. Sidestone Press, Leiden

Sørensen, M., 2006. Teknologiske traditioner i Maglemosekulturen. En diakron analyse af Maglemosekulturens flækkeindustri. *In*: B.V. Eriksen, ed. *Stenalderstudier. Tidligt mesolitiske jægere og samlere i Sydskandinavien*, 19-75. Jysk Arkæologisk Selskabs Skrifter 55. Højbjerg: Jysk Arkæologisk Selskab, 19-75.

Sørensen, M., 2007. *Teknologi, typologi og traditioner på Dværgebakke I (HEM 2981), Bølling Sø. Foreløbige undersøgelser og tolkninger af stenalderens tidligste bosættelser ved Bølling Sø ud fra det litiske materiale.* Museum Midtjylland.

Sørensen, M., 2012. The Arrival and Development of Pressure Blade Technology in Southern Scandinavia. *In*: P. Desrosiers, ed. *The Emergence of Pressure Blade Making.* Boston: Springer, 237-259.

Sørensen, M., Rankama, T., Kankaanpää, J., Knutsson, K., Knutsson, H., Melvold, S., Eriksen, B.V., Glørstad, H., 2013. The First Eastern Migrations of People and Knowledge into Scandinavia: Evidence from Studies of Mesolithic Technology, 9th-8th Millennium BC. *Norwegian Archaeological Review,* 46:1, 19-56, https://doi.org/10.1080/00293652.2013.770416

Sørensen, M., 2018. Early Mesolithic Regional Mobility and Social Organization: Evidence from Lithic Blade Technology and Microlithic Production in Southern Scandinavia. *In*: K. Knutsson, H. Knutsson, J. Apel and H. Glørstad, eds. *Technology of Early Settlement in Northern Europe. Transmission of Knowledge and Culture.* Sheffield: Equinox Publishing Ltd, *173-199*.

Sørensen, M., Lübke, H., Groß, D., 2018. The Early Mesolithic in Southern Scandinavia and Northern Germany. *In*: N. Milner, C. Conneller and B. Taylor, eds. *Star Carr Volume 1: A Persistent Place in a Changing World.* York: White Rose University Press, 305-329

Sørensen, S. A., 2017. *The Kongemose Culture.* Nordiske fortidsminder, Serie B, Nr. 27. Odense: Syddansk Universitetsforlag.

Tauber, H., 1971. Danske Kulstof-14 Dateringer af Arkæologisk Prøver III. *Aarbøger for Nordisk Oldkyndighed og Historie* 1970, 120-142.