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University of Bergen Archaeological Series

The Stone Age Conference in Bergen 2017

Dag Erik Færø Olsen (ed.)

UNIVERSITY OF BERGEN

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Stone hatchet from the middle Mesolithic site Hovland 3, Larvik municipality, Vestfold and Telemark county (No.: Cf34100_617). Photo: Kirsten Helgeland, KHM.

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Preface

This anthology is based on contributions presented as part of *The Stone Age Conference in Bergen 2017 – Coast and Society, research and cultural heritage management*. The conference was co-organized by the Department of Archaeology, History, Cultural Studies and Religion (AHKR) at the University of Bergen and the Department of Cultural History at the University Museum of Bergen (UM). The organizing committee included Dag Erik Færø Olsen (leader) and Tina Jensen Granados from AHKR, together with Leif Inge Åstveit and Knut Andreas Bergsvik from UM.

The Stone Age Conference in Bergen 2017 was the third instalment of the "Stone Age Conference" series to be organized in Norway. The first conference was held in Bergen in 1993 (Bergsvik *et al.* 1995) and the second in Molde in 2003. The purpose for the 2017 conference in Bergen was to gather archaeologists with common interest in the Norwegian Stone Age and from all parts of the national Stone Age community. Several prominent research communities exist in Norway today and representatives from all University departments and from the majority of the County Municipalities was gathered to share current results and to discuss common issues and strategies for future research.

Since the last conference in 2003, the cultural heritage management in Norway has made large quantities of new archaeological data accessible for research. Such extensive new data has provided new methodological and theoretical challenges and opportunities which is reflected in the scope of research published within the last 20 years.

The Stone Age Conference in Bergen 2017 wanted to reflect the new empirical, theoretical and methodological diversity, and to highlight how these developments could be integrated into the cultural heritage management and within future research. The conference was structured by current themes and approaches and divided into five main sessions (including a poster session) and seven session themes (see Sessions and papers at the end of this volume).

An increasing association with the *natural scientific approaches* was one important theme of the conference focusing on research on climate change, aDNA and new and improved methods for analysis and dating. Related to this was the general theme *technology* were studies on raw material and technological studies are used in mobility- and network analysis.

Managing and utilizing the large quantities of data generated over the last two decades was the basis for the themes *demography* and *subsistence changes*. The theme *methodological developments* included increasing digitalization and how this is used in rescue archaeology, with challenges and new possibilities. The conference also wanted to explore aspects of *ritual communication* where various forms of expressions, such as rock art, could elaborate and increase our understanding of several of the other main themes mentioned.

During the three days of the conference a total of 46 15 minutes presentations addressed various topics and aspects within the seven session themes. All sessions were led by session leaders and three of the conference sessions were introduced by key note speakers.

After the conference, it was decided to publish an anthology, inviting all participants to contribute including the poster participants. The publication was to be in the University

of Bergen Archaeological Series, UBAS, and with Dag Erik Færø Olsen as editor of the anthology. Ten papers were submitted from all the sessions and is representative of the topics presented and discussed during the three-day conference. The papers included in this volume are organized mainly geographically starting with Northern Norway moving southwards.

Kenneth Webb Vollan focuses on housepit sites in Arctic Norway using radiocarbon dates for distinguishing reuse or occupational phases. He presents a method for analysing dates following the Bayesian approach and shows that the housepits were reused to a much larger degree than previous acknowledged.

Skule Spjelkavik and *Axel Müller* explores similar topics in their paper about quartz crystal provenance. By using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) they were able to compare debitage from the Early Mesolithic settlement site Mohalsen I at the island Vega with samples from 19 known sources in Norway. This is especially interesting since there are no known quartz crystal occurrences at Vega and was consequently brought from the main land or other areas. This study shows the potential for using this method, even though no clear parallel to the Mohalsen debitage could be identified in the analysed material.

Jan Mangerud and *John Inge Svendsen* explores colonization processes from a geological perspective. They document how an ice sheet margin presented a physical barrier across the Oslofjord preventing human immigration until the onset of the Holocene, providing an interesting backdrop for discussing aspects of colonization processes in the Early Mesolithic.

Arne Johan Nærøy discusses the use of tools and behaviour patterns based on use-wear analysis of quartz assemblage from the site 16 Budalen in Øygarden, Hordaland County. He is able to distinguish two individuals operating at the site suggesting spatially segregated work operations. Nærøy shows through this study the potential for functional analysis of lithic material from settlement sites.

Astrid Nyland, Kidane Fanta Gebremariam and *Ruben With*'s contribution represents both the new technological and methodological developments and the interdisciplinary nature of archaeology today. This paper explorers the potential for using pXRF for regional provenance analysis of greenstone adzes in western Norway. This study revisits an older interpretation of the division of this region into two social territories in the Middle and Late Mesolithic. The results show that the method is robust and well suited for studying green stone and the authors can also largely confirm the original interpretations based on distribution networks of Mesolithic adzes.

Birgitte Skar discusses the early postglacial migration into Scandinavia based on aDNA studies on two Early Mesolithic Norwegian skeletons. Skar's results confirms the recent interpretation of a second migration into Norway from the Northeast thus contributing to the overall narrative of the colonization of Norway.

Almut Schülke revisits the topic of Mesolithic burial practises in Norway based on new data from recent excavations. Schülke highlights that human remains are often found at settlement sites, opening for discussions of various relationships between the living and the dead and human-nature engagement.

Krister Eilertsen presents results from an excavation of an Early Neolithic hut in Rogaland, Southwestern Norway. He discusses classical interpretative challenges where the lithic material and ^{14}C-datings are not comparable. Eilertsen emphasise the importance of not dismissing difficult results but rather try to find an answer to the differences in light of a wider analysis of the area including various natural and cultural processes. He is thus able to explain the contrasting data and provide new insight into settlement patterns and economy at the start of the Neolithic.

Dag Erik Færø Olsen reviews the rock shelters in the mountain regions of Hardangervidda and Nordfjella. The previous interpretation of these settlement sites as primarily from the Late Neolithic and onwards is discussed based on a reclassification of archaeological material. The results show that rock shelters have been used from at least the Middle Mesolithic and in some cases with an intensification and stronger continuity after 2350 BC.

Gaute Reitan discusses the chronological division of the Mesolithic based on new data from excavations the last 20 years. Reitan presents a revised chronology for the Mesolithic in Southeast Norway dividing each of the three main phases into two sub-phases, adding two new phases to Egil Mikkelsen's original from 1975.

Acknowledgements

On the behalf of the organizing committee, we would like to thank all participants of *Steinalderkonferansen i Bergen 2017* for sharing their knowledge and for the discussions that followed at the conference. We also want to express our gratitude to the conference key note speakers, Prof. Kjel Knutsson (Dep. of Archaeology and Ancient History, Uppsala University), Assoc. Prof. Per Persson (Dep. of Archaeology, Museum of Cultural History, University of Oslo) and Prof. Charlotte Damm (Dep. of Archaeology, History, Religious Studies and Theology, The Arctic University of Norway) for introducing three of the conference sessions. This gratitude is also extended to five session leaders, Assoc. Prof. Arne Johan Nærøy (Museum of Archaeology, University of Stavanger), Prof. Marianne Skandfer (The Arctic University Museum of Norway), Assoc. Prof. Birgitte Skar (Dep. of Archaeology and Cultural History, NTNU University Museum), Prof. Hans Peter Blankholm (Dep. of Archaeology, History, Religious Studies and Theology, The Arctic University of Norway) and Prof. Almut Schülke (Dep. of Archaeology, Museum of Cultural History, University of Oslo).

During the three-day conference the committee received assistance from voluntary students from The University of Bergen and they provided valuable help during the conference.

We would also like to thank the following institutions for their generous funding:

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The editor of this anthology would further like to express gratitude to all the anonymous peer reviewers whose valuable comments and insights has made this publication possible.

Last, but not least, thank you to the authors of this anthology for the patience and work on the papers that make out this volume.

Dag Erik Færø Olsen and Tina Jensen Granados – Oslo 2021

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Gaute Reitan

A Revised Chronology of the Mesolithic in Southeast Norway

Abstract

A chronological outline of the Mesolithic in southeast Norway was published by Egil Mikkelsen in 1975, dividing the Mesolithic period into four succeeding phases. Since then, this chronology has remained the main framework for arranging Mesolithic settlement finds, although with slight later adjustments. However, when Mikkelsen published his study, very few settlement sites had been excavated. This has now changed, as a large number of sites have been investigated in recent years. The data from these sites have dramatically raised the potential for studies into the chronological development in the region. However, the newly unearthed assemblages are in some cases difficult to fit into the established chronology. In this paper, the empirical foundation of the established Mesolithic chronology is reassessed, and it is concluded that the chronological scheme is due for a revision. Based on a high number of recently excavated sites and associated radiocarbon dates, a revised chronology of the Mesolithic in southeast Norway is suggested. It is claimed that six Mesolithic phases can be distinguished – three main phases (Early, Middle and Late Mesolithic), with each of them, in turn, divided into two sub-phases.

Introduction

In 1975, Egil Mikkelsen published a study on changes in the ecological adaptation during the Mesolithic of southeast Norway (Mikkelsen 1975a). A chronological framework has been recognised as the most important contribution made by this study – a framework that divides the Mesolithic into four subsequent phases. Mikkelsen's chronology was the first chronology outlined for southeast Norway, and it was developed on local shoreline-displacement curves, local finds and typological patterns expressed in the native archaeological record. Although subjected to adjustments after later excavations, Mikkelsen's four-phased division (Fig. 2) persists as the main reference for the Mesolithic in southeast Norway. Initially in this paper, I will present Mikkelsen's chronology and discuss the revisions that were suggested and widely accepted around the turn of the millennium. Until recently, however, certain transitional sequences have only been partly explored. This situation has now drastically altered, as a rich data material from a multitude of excavations during the last decades sheds new light on the long-term chronological and technological trajectory in the region. This newly excavated material has turned out to be difficult, at least in part, to fit into the four-phased scheme first suggested by Mikkelsen more than 40 years ago. It is consequently argued in this paper that the established Mesolithic chronology is due for a revision. Based on technological shifts and what I consider as chronologically dependent trends in the recently recorded assemblages,

along with new local shoreline displacement curves and a large number of radiocarbon dating results (cf. Solheim and Persson 2018), it is possible to distinguish six different phases in the Mesolithic (Fig. 2 and 17). This new chronological outline also provides new dating frames for classic tool-types, such as the Nøstvet adze, the chubby adze and the handle-core. The revised chronological outline relies heavily on data obtained within two large-scale excavation projects – one carried out in the counties of Vestfold and Telemark in 2010–2012 (Melvold and Persson 2014, Reitan and Persson 2014), the other in the county of Aust-Agder in 2014–2016 (Reitan and Sundström 2018). Additionally, my analysis encompasses a comprehensive body of data from other excavations, both published and previously unpublished, across southeast Norway (Fig. 1). Artefacts typical for the period like axes/adzes, cores, blades/microblades and projectile points are, along with flint reduction strategies, all central in my reassessment – find categories that have traditionally been pivotal in the chronological discourse on the Mesolithic (Fig. 3–6). Although the present study is based mainly on excavated material from the Oslo Fjord area, the conclusions are arguably relevant to the bordering areas of western Sweden at least south to the Gothenburg area (for the chronology of the Mesolithic in the coastal areas of western Sweden, see e.g. Jonsäter 1984, Nordqvist 2000a, Johansson *et al.* 2013, Lindman 2013a, p. 9, 2013b), and likely also Denmark in terms of contact networks (e.g. Nielsen *et al.* 2019, p. 88).

In part, this study overlaps with a previously published paper in norwegian (Reitan 2016). However, the results in the present paper are based on a considerably larger amount of site-data. Additionally, this study includes a discussion of the Early Mesolithic, unlike the previously published paper.

The study area and the level of archaeological activity

A mountain range divides southern Norway, i.e. south of Trøndelag in central Norway, into an easterly and a westerly half. The easterly of the two, in total c. 95,000 km^2, is archaeologically administered by the Museum of Cultural History, University of Oslo (Fig. 1). A major part of this area constitutes a large drainage basin with big river systems running from the mountains through several long valleys cutting through the landscape towards the coastline around the Oslo Fjord. The areas along the coast are largely characterized by hilly terrains with a steep drop to the fjords and the present-day shoreline.

So far (winter 2019/2020), approximately 460 sites from different parts of the Stone Age have been investigated within this area since the turn of the millennium (Reitan 2018a). Archaeologically, the coastal areas surrounding the Oslo Fjord are the most intensely investigated (cf. Glørstad 2006, 2010). Overall, the recorded data from these examined sites constitute an information potential which is exceptional in a European perspective.

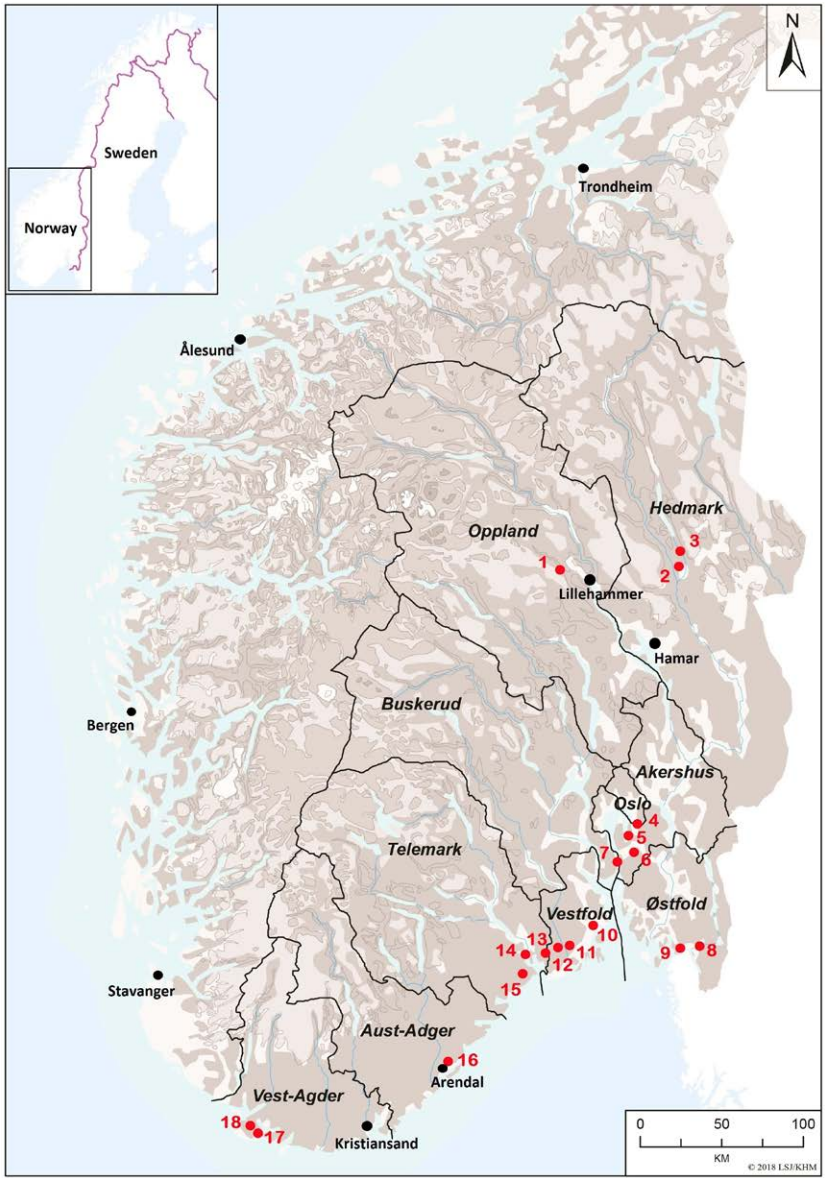

***Figure 1**: Important multi-site Stone Age excavations carried out in southeast Norway over the last decades: 1) Dokkfløy, 11 sites (Boaz 1998), 2) Rødsmoen, 14 sites (Boaz 1997), 3) Gråfjell/Rena elv, 25 sites (Stene 2010), 4) Follobanen/Elgsrud, 5 sites (Eymundsson and Mjærum 2015; Eymundsson et al. 2018), 5) Vinterbro, 3 sites (Jaksland 2001), 6) E6/Dobbeltspor, 12 sites (Berg 1995, 1997), 7) Oslofjordforbindelsen, 10 sites (Ballin 1998), 8) Halden, 5 sites (Lindblom 1990), 9) Svinesund, 15 sites (Glørstad 2004), 10) Brunstad, 3 sites (Reitan et al. 2019, Schülke et al. 2019), 11) E18 Bommestad–Sky, 11 sites (Solheim and Damlien 2013), 12) E18 Brunlanes, 10 sites (Jaksland 2012a, 2012b, Jaksland and Persson 2014), 13) Vestfoldbanen, 29 sites (Melvold and Persson 2014, Reitan and Persson 2014, Reitan 2016), 14) Skutvikåsen, 3 sites (Ekstrand 2013), 15) E18 Rugtvedt–Dørdal, 30 sites (Solheim 2017), 16) E18 Tvedestrand–Arendal, 34 sites (Reitan and Sundström 2018), 17) Farsund, 28 sites (Ballin and Jensen 1995), 18) Lundevågen, 8 sites (Berg-Hansen 2010; Reitan 2010). Map produced by L.S. Johannessen/G. Reitan (after Reitan 2018a).*

The importance of shoreline displacement curves

Due to the continuous postglacial land uplift, shore-bound settlement sites from the Mesolithic period are situated on dry land around the Oslo Fjord and south to the Arendal-Grimstad area, Aust-Agder. The archaeological investigations carried out in the region leave a distinct impression of a Mesolithic population that has relied heavily on marine resources, a trait already pointed out by Brøgger over a hundred years ago (A.W. Brøgger 1906, cf. W.C. Brøgger 1905, but see e.g. Mjærum 2018). The connection between the settlement and the contemporary sea is reflected in both the ecofact material and in stable isotopes in human bones when preserved, as well as in the distribution of the settlement sites – the sites have often been located on terraces on slopes and with easy access to the contemporary shore (e.g. Mikkelsen 1975b, Breivik 2014, Jaksland 2014, Persson 2014a, Skar *et al.* 2016, Boethius and Ahlström 2018, Breivik *et al.* 2018, Darmark *et al.* 2018a, cf. Åkerlund and Nordqvist 1997). Consequently, a detailed knowledge of the sea level displacement provides critical input for an understanding of the diachronic settlement patterns and of landscape use in a spesific coastal area. Mappings of the sea level changes, carried out by geologists, have therefore been undertaken as integrated parts of several large-scale archaeological excavation projects in recent years (Sørensen *et al.* 2014a, 2014b, Romundset 2018, Romundset *et al.* 2018). The postglacial sea level changes rely on a number of factors, and substantial differences in the course of shoreline displacement within short distances have been documented. This important aspect has recently been convincingly demonstrated by Anders Romundset (2018) in connection with the excavations carried out by the *E18 Tvedestrand–Arendal project* (Reitan and Sundström 2018). The rapid land uplift, most notable in the first part of the Holocene, combined with a hilly landscape, makes well-dated shoreline displacement curves highly reliable and precise tools for dating sites located on ancient raised shorelines, not least when organic material suited for radiocarbon dating is lacking – a problem commonly encountered in Early and Middle Mesolithic contexts (cf. Jaksland 2014, p. 43–44, Damlien 2016a, p. 24–26, Solheim and Persson 2018, Viken and Reitan 2018). It must be stressed, however, that shoreline dating of a site relies on the premise that the given site has in fact been shore-bound (Mikkelsen 1975a, p. 20, cf. Åkerlund and Nordqvist 1997, Berg-Hansen 2009).

The establishment of a Mesolithic chronology for southeast Norway, and later revisions

For decades the Mesolithic of southeast Norway was divided into two phases (or 'cultures') – the Early Mesolithic *Fosna phase* and the Late Mesolithic *Nøstvet phase* (e.g. Nummedal 1929, Gjessing 1945, cf. Mikkelsen 1975a, p. 19–20). Up until Mikkelsen's study was published, it was even discussed whether the foraging 'Nøstvet people' possibly lived side by side with an Early Neolithic farming population (Ingstad 1970). Instead, Mikkelsen (1975a) suggested a division of the Mesolithic into four phases with the *'Fosna culture'* (phase 1) and *'Late Boreal/ Early Atlantic settlement sites'* (phase 2) as the two earliest, constituting the Early and Middle Mesolithic, respectively. The Late Mesolithic was divided into two sub-phases – the *'Nøstvet culture'* (phase 3), and a transition phase between the Nøstvet phase and the Early Neolithic – the *'late flint-point-using groups'* (phase 4) (Fig. 2). Mikkelsen (1975a, p. 24–26) based his chronological outline mainly on shoreline displacement curves combined with the presence or absence of certain tool types that he considered characteristic of the different phases, such as flint cores, axes/adzes and projectile points.

By the early 1970s, relatively few coastal settlement sites that could shed light on the chronological trajectory in southeast Norway had been properly investigated, and very few radiocarbon dating results had been obtained. Moreover, the material recorded from the Kjeøy site itself, the basis for Mikkelsen's fourth and last Mesolithic phase, had not even been archaeologically excavated, only superficially collected. It can therefore be claimed that Mikkelsen's suggested chronology was both bold and hampered by uncertainties. Nevertheless, Mikkelsen's four-phased Mesolithic chronology remains the current scheme according to which eastern Norwegian settlement material is sorted, albeit slightly adjusted after later studies and excavation projects (Lindblom 1984, Ballin 1995, 1999a, 1999b, 2000, 2004, Berg 1995, 1997, Jaksland 2001, Glørstad 1998a, 2002, 2004, 2011). In his synthesising of the results of a large-scale excavation project at Svinesund in Halden, Østfold County in 2001–2003, Glørstad (2004) suggests a more nuanced version of Mikkelsen's scheme (Fig. 2).

Below, I will briefly introduce the basis for the current Mesolithic chronology of southeast Norway. This introduction will also constitute the foundation for my subsequent reassessment.

As previously pointed out, geographically southern Norway consists of two halves – western Norway and eastern (or southeastern) Norway (Norw. '*Vestlandet*' and '*Østlandet*', respectively). The two halves are treated as materially separate regions throughout the Mesolithic, and with deviating chronological schemes (for the chronology of western Norway, see e.g. Bruen Olsen and Alsaker 1984, Bruen Olsen 1992, Nærøy 1993, 1999, Bjerck 1986, 2008a, 2008b, Bjerck *et al.* 2008). For southeast Norway, there is a tradition for basing chronological transitions on trends and breaks in the archaeological record through time. In comparison, recent studies of the long-term trajectory of western Norway have suggested a division of the Mesolithic into eleven *chronozones* (EM1–3, MM1–3, LM1–5), each of them lasting 500 calendar years (Bjerck 2008a, 2008b, Bjerck *et al.* 2008). The chronozones are intended to provide a neutral time reference system that may clarify the presentation of variations in the archaeological record across different regions. If applied in a rigid manner, however, my view is that chronozones may blur potentially important shifts in the archaeological record within the different chronozones.

<table>
<tr><th>Phase</th><th>Mikkelsen 1975a</th><th>Berg 1995, 1997</th><th>Ballin 1998, 1999a, 2004</th><th>Jaksland 2001</th><th>Glørstad 2002, 2004</th><th>Reitan, present paper</th></tr>
<tr><td rowspan="2">Early Mesolithic</td><td rowspan="2">Phase 1, ‘Fosna culture’ 9300–7400 BC (9800–8300 BP)</td><td rowspan="2">Phase 1/Fosna 9300–7400 BC (9800–8300 BP)</td><td>EMA 9500–8800 BC (10,000–9500 BP)</td><td rowspan="2">EM 9500–8250 BC (10,000–9000 BP)</td><td rowspan="2">Fosna phase 9500–8250 BC (10,000–9000 BP)</td><td>EM1 9300–8600 BC (9800–9350 BP)</td></tr>
<tr><td>EMB 8800–8250 BC (9500–9000 BP)</td><td>EM2 8600–8300 BC (9350–9100 BP)</td></tr>
<tr><td rowspan="2">Middle Mesolithic</td><td rowspan="2">Phase 2, ‘Late Boreal/ Early Atl. settlement sites’ 7400–6300 BC (8300–7400 BP)</td><td>Phase 2/MM 7400–6600 BC (8300–7800 BP)</td><td>MMA/Tørkop phase 8250–7500 BC (9000–8400 BP)</td><td rowspan="2">MM 8250–6350 BC (9000–7500 BP)</td><td rowspan="2">Tørkop phase 8250–6350 BC (9000–7500 BP)</td><td>MM1 8300–7000 BC (9100–8000 BP)</td></tr>
<tr><td rowspan="4">Phase 3/Nøstvet 6600–4400 BC (7800–5600 BP)</td><td rowspan="2">MMB/ Lundevågen phase 7500–6350 BC (8400–7500 BP)</td><td rowspan="4">MM2 7000–5600 BC (8000–6700 BP)</td></tr>
<tr><td rowspan="4">Late Mesolithic</td><td rowspan="2">Phase 3, ‘Nøstvet culture’ 6300–5300 BC (7400–6300 BP)</td><td rowspan="2">Nøstvet phase 6350–4400 BC (7500–5600 BP)</td><td rowspan="3">Nøstvet phase 6350–4650 BC (7500–5800 BP)</td><td>Nøstvet phase, early 6350–6000 BC (7500–7100 BP)</td></tr>
<tr><td>Nøstvet phase, middle 6000–5700 BC/ (7100–6800 BP)</td></tr>
<tr><td rowspan="3">Phase 4, ‘Late flint-point-using groups’ 5300–3800 BC (6300–5000 BP)</td><td>Nøstvet phase, late 5700–4650 BC (6800–5800 BP)</td><td>LM1 5600–4500 BC (6700–5650 BP)</td></tr>
<tr><td>Phase 4 4400–3800 BC (5600–5000 BP)</td><td>Gjølstad phase 4400–4000 BC (5600–5200 BP)</td><td rowspan="2">Transverse arrowhead phase 4650–3800 BC (5800–5000 BP)</td><td>Kjeøy phase, early 4650–4300 BC (5800–5500 BP)</td><td rowspan="2">LM2 4500–3900 BC (5650–5100 BP)</td></tr>
<tr><td>Kjeøy phase, late 4300–3800 BC (5500–5000 BP)</td></tr>
</table>

***Figure 2**: Main studies discussing chronological questions in Mesolithic southeast Norway, with the terms used by the various scholars. Abbreviations: ‘EM’ = Early Mesolithic, ‘MM’ = Middle Mesolithic, ‘LM’ = Late Mesolithic (cf. Figs 3–6).*

The Early Mesolithic (phase 1), c. 9500–8250 cal. BC (c. 10,000–9000 BP)

According to Mikkelsen (1975a, p. 23–26) a typical Early Mesolithic inventory is characterized by a varied projectile point material (microliths, single-edged points, tanged points), microburins, flake axes and blades primarily struck from one- or two-sided cores with one platform (Fig. 8).

Until recently, a low number of excavated Early Mesolithic sites have provided a poor basis for a discussion of the development of such material in southeast Norway. Nevertheless, some technological traits have been identified, and the microburin technique, as well as the projectile points and the axe material, have been central in the discussion. Certain trends in

the material within the Early Mesolithic have been suggested as chronologically dependent, not least in the wake of the *E18 Brunlanes project* investigations in 2006–2007 (Jaksland 2012a, 2012b, Jaksland and Persson 2014, see also Bang-Andersen 1990, Ballin 2004).

Important later contributions to the chronology of the Early Mesolithic are highlighted in Figure 3.

The Early Mesolithic		
Project, location (literature)	Chronological closures	Key sites, dating methods
Various sites in southwest and southeast Norway (Bang-Andersen 1990, Ballin 1999a, 2004, Fuglestvedt 1999, 2007, Waraas 2001)	Based on fluctuations in the arrowhead/microlith ratio, the Early Mesolithic can be divided into two sub-phases. The older, EMA, is characterized by Zonhoven points, tanged points with the proximal end possibly removed by bilateral microburin technique, and single-edged points with the tip in the proximal end. Blades are produced from unilateral cores. The replacement of these types by simple lanceolates produced by unilateral microburin technique, and the presence of flake axes and core adzes are characteristic of the younger sub-phase, EMB. Conical cores may occur toward the end of EMB. The dating of the transition between the two sub-phases is uncertain, but the time around 8800 BC is suggested by Bang-Andersen (1990). On coastal sites, flint is the dominant raw material throughout the EM.	The Myrvatn sites The Fløyrlivatn sites The Høgnipen sites The Galta sites Stunner Typology/technology/ shoreline/C14
Various sites along the coast of Norway (Bjerck 2008a, 2008b)	Bjerck suggests a division of the Early Mesolithic (c. 9500–8000 BC) into three *chronozones*, EM1–EM3, each lasting 500 calendar years. However, Bjerck's subdivision is not based on specific material or technological changes.	
The E18 Brunlanes project, Larvik municipality, Vestfold County (Jaksland 2012a, 2012b, 2014, Jaksland and Fossum 2014)	A subdivision of the EM into three sub-phases is suggested by Jaksland (2014), and at first sight, this subdivision is quite similar to that of Bjerck (2008). The main objective of Jaksland's division, though, is to call attention to the implications of two significant plateaus in the calibration curve within the EM. Nevertheless, certain chronologically dependent trends are pointed out in the axe and projectile material (Jaksland & Fossum 2014): through the 'Pauler sequence', ranging from c. 9000 to c. 8600 cal. BC, there is a decrease in single-edged and tanged points. Correspondingly, Høgnipen points and simple lanceolates gradually become more common. Locally available rock (metarhyolite) is also introduced as raw material for flake- and core axes during the EM. The morphology of the flake axes/-chisels seems to change over time, becoming gradually narrower and core-axe-like.	Pauler 1–7 Bakke Typology/technology/ shoreline

***Figure 3**: Important contributions into the chronology of the Early Mesolithic period.*

The Middle Mesolithic (phase 2), c. 8250–6350 cal. BC (c. 9000–7500 BP)

As typical artefacts of the Middle Mesolithic, Mikkelsen (1975a, p. 26) mentions, among other things, microliths such as the single barbed point (or barbed lancet, Norw. *hullingspiss*, see Fig. 10C) and the scalene triangle, along with blades, microblades, handle cores and conical cores. Cores with associated blades/microblades as well as microliths and stone adzes have since been central in discussions concerning the chronological development in the Middle Mesolithic.

More recent excavation results and publications that shed light on this phase are briefly summarised in Figure 4.

The Middle Mesolithic		
Project, location (literature)	Chronological closures	Key sites, dating methods
The Farsund project, Farsund municipality, Vest-Agder County Various sites along the coast of southern Norway (Ballin & Jensen 1995, Ballin 1995, 1999a, 1999b, Mikkelsen et al. 1999, Ballin 2004)	The Middle Mesolithic is divided into two halves. The first is the MMA/'the Tørkop phase' (c. 8250–7500 BC) with a microlith material dominated by barbed points (barbed lancets) produced by microburin technique. Core adzes also occur. The second is the MMB/'the Lundevågen phase' (c. 7500–6350 BC), in which the microlith material is dominated by scalene triangles produced without using the microburin technique, and barbed points and core adzes are no longer in use. The average blade width and platform flaking angle differ between the two halves of the MM. The discontinued use of scalene triangles marks the end of the MM.	Lundevågen R17 Lundevågen R21/22 Tørkop Typology/technology/C14
The Vinterbro project, Ås municipality, Akershus County (Jaksland 2001)	Scalene triangles manufactured without the use of microburin technique also occur in the early MM, whereas barbed points are only recorded from contexts dated to the first part of the MM. Jaksland (2001) therefore rejects Ballin's (1999a) division of the MM into two sub-phases based on average blade width and flaking angle. The use of bipolar cores increases throughout the MM, and rock adzes and mace heads are introduced c. 7500 BC.	Vinterbro 12 Vinterbro 9 Vinterbro 3 (Rørmyr II) Typology/technology/shoreline
The E18 Bommestad–Sky project, Larvik municipality, Vestfold County (Damlien and Solheim 2013, Solheim 2013, Damlien 2016)	Serial production of blades and microblades from conical or semi-conical cores is the prevalent technological concept throughout the phase. Other platform cores as well as bipolar cores also occur. Scalene triangles are in use throughout the phase, but barbed points no later than c. 7500 BC. Microliths are often recorded along with microblades with informal secondary working along the edges, but which cannot be classified as typical microliths. The production of pecked stone adzes with round/oval cross-section ('chubby adzes') and core adzes of metarhyolite (a flint-like rock type) is documented from c. 7800 BC. Mace heads/hatchets with shaft-hole occur after c. 7500 BC.	Hovland 1 Hovland 2 Hovland 3 Hovland 4 Hovland 5 Nordby 2 Torstvet Typology/technology/shoreline/C14

***Figure 4**: Important contributions into the chronology of the Middle Mesolithic period.*

The Late Mesolithic Nøstvet phase (phase 3), c. 6350–4650 cal. BC (c. 7500–5800 BP)

The Nøstvet adze is recognized as the key artefact typical of this phase (Mikkelsen 1975a, p. 26; cf. Jaksland 2005, Glørstad 2010, 2011) – a coarse stone core adze manufactured by flake reduction along the sides of a blank with a flat ventral side. The production process provides a characteristic three-sided cross-section, commonly also with a pointed neck and normally the grinding of Nøstvet adzes is limited to the convex edge. Other typical finds are grinding slabs and knives of sandstone with polished edges, small flint tools like flake borers, flake scrapers with convex retouch, and irregular cores, handle cores and microblades (Fig. 12). As for the transition between the Middle Mesolithic and the Late Mesolithic Nøstvet phase (phases 2 and -3 respectively), Mikkelsen specifically underlined the cessation in the production of microliths and the increased production of microblades from handle cores. In addition, he pointed out that the adze material of the Nøstvet phase differs from that of the preceding and the subsequent phases, and that borers were more common in the Nøstvet phase.

The Nøstvet adze and the microblade production have been central issues in research into the Late Mesolithic Nøstvet phase – see Figure 5.

The Late Mesolithic Nøstvet phase		
Project, location (literature)	Chronological closures	Key sites, dating methods
The Dobbeltspor/E6 project, Vestby, Ås and Frogn municipalities, Akershus County (Berg 1995, 1997)	The Nøstvet adze is introduced c. 6600 BC, and it is suggested that the MM–LM transition be backdated to this point. The Nøstvet adze is in use throughout the Nøstvet phase, whereas the use of chubby adzes ceases c. 5800 BC. In addition to a comprehensive adze material, sandstone knives and thick flint borers are characteristic of the Nøstvet phase. A division of the Nøstvet phase into three sub-phases, based on the blade/microblade material, is cautiously suggested: narrow microblades dominate in the middle sub-phase, wider blades are more common in the earliest and the latest sub-phases.	Rød nedre R72 Trosterud lok. 1 Kvestad lok. 2 Kvestad lok. 3 Typology/shoreline/C14
Oslofjordforbindelsen, Hurum and Frogn municipalities, Buskerud and Akershus Counties respectively (Ballin 1998)	The introduction of the handle core marks the beginning of the Nøstvet phase, dated c. 6300–6000 BC.	Kongsdelene R71-2 Kongsdelene R62 Storsand R53 Typology/technology/shoreline/C14

Continues

The Late Mesolithic Nøstvet phase		
Project, location (literature)	Chronological closures	Key sites, dating methods
The Svinesund project, Halden municipality, Østfold County (Glørstad 2002, 2004)	The discontinued use of of microliths marks the MM–LM transition. Based on fluctuations in certain artefact types, the Nøstvet phase is divided into three sub-phases. In the early sub-phase (c. 6350–6000 BC) the adze material is dominated by chubby adzes with round cross-sections. The typical Nøstvet adze with its characteristic three-sided cross-section is still not introduced, neither are thick flint borers. The blade assemblages consist of a large number of blades *versus* microblades. Grinding slabs of sandstone and handle cores of flint are so far uncommon. The middle sub-phase of the Nøstvet (c. 6000–5700 BC) is characterized in particular by chubby adzes with a plane ventral side and a heavily curved dorsal side, forming a semi-circular cross-section. In the last sub-phase (also termed 'classic Nøstvet', 5700–4650 BC) the chubby adzes are completely replaced by the Nøstvet adzes. Adzes and adze-related debris is now more common than in the earlier sub-phases, but seems to decrease toward the end of the period. Microblades, handle cores/keel-shaped cores and coarse borers with a triangular cross-section are more common types than in the preceding sub-phases of the Nøstvet phase.	Torpum 1 Torpum 2 Torpum 9a Torpum 9b R16 Rørbekk 1 Berget 1 Typology/technology/shoreline/C14

***Figure 5**: Important contributions into the chronology of the Late Mesolithic Nøstvet phase.*

The Late Mesolithic Kjeøy phase (phase 4), c. 4650–3800 cal. BC (c. 5800–5000 BP)

The transitional Kjeøy phase, between the Nøstvet phase and the Neolithic, constitutes an important component in Mikkelsen's scheme. The separation of the Kjeøy phase was based on a rich, surface-collected, but not archaeologically unearthed, settlement site in Halden, Østfold County. The collected assemblage from the Kjeøy site differed from that of the preceding Nøstvet phase sites of the same region. The most important elements from the Kjeøy site are projectile points of flint – transverse-tipped arrowheads, tanged type A points and single-edged points. The Kjeøy site material also encompasses a relatively large portion of blade tools. Only one fragmented and atypical adze was found on the Kjeøy site. This led Mikkelsen (1975a, p. 30–31) to conclude that the stone adze material of the Kjeøy phase is scarce, and that adzes do not characterize this phase in the same manner as they do the Nøstvet phase.

The introduction of the arrowheads as well as the ratio of blades (> 8 mm wide) to microblades (< 8 mm wide, cf. Helskog *et al.* 1976, p. 14) are central elements in the research into the final Mesolithic Kjeøy phase – see Figure 6.

To sum up, the Nøstvet phase is so far the most intensively studied of the different Mesolithic phases (Jaksland 2005, p. 32). Even so, the establishment of the duration of the Nøstvet phase must be considered uncertain. Although it is unclear which material changes provide a valid basis for dating, the transition between the Middle and Late Mesolithic (Mikkelsen's phases

2 and -3) is commonly dated to c. 6350 cal. BC (see Fig. 2). The typical traits of the two Late Mesolithic sub-phases, i.e. the Nøstvet phase and the Kjeøy phase (phases 3 and -4), are fairly well mapped (see Figs. 5 and 6). However, the date of the transition between the two has not been established to a satisfactory degree, in my opinion. The same applies to the Late Mesolithic–Early Neolithic transition. In light of new excavation results, I will discuss these vaguely dated and unconvincingly defined transitions below.

The Late Mesolithic Kjeøy phase		
Project, location (literature)	Chronological closures	Key sites, dating methods
The Dobbeltspor/E6 project, Vestby, Ås and Frogn municipalities, Akershus County (Berg 1995)	The transition between the Nøstvet phase and the Kjeøy phase is marked by the introduction of arrowheads of flint. This coincides with a technological shift encompassing an abrupt decrease in microblade production. A notable number of knives and scrapers are made of blades. The transition between the two Late Mesolithic sub-phases is dated to c. 4400 BC, but cannot be established with certainty – a dating of the transition to 4800 BC is possible.	Gjølstad R33 Typology/technology/ shoreline/C14
Various sites in Østfold and Akershus counties (Glørstad 1998a) *The Svinesund project*, Halden municipality, Østfold County (Glørstad 2002, 2004)	This final Mesolithic stage is divided into an early and a late sub-phase. The earlier is characterized by transverse-tipped arrowheads as the only projectile type. Additionally there are several similarities with settlement site material from the latest part of the Nøstvet phase – one of these similarities is that there are more microblades than blades as well as conical/semi-conical and microblade cores and handle cores. The few occurring adzes are atypical and are easily distinguished from the adzes of the Nøstvet phase. In the later sub-phase of the Kjeøy phase, i.e. from c. 4300 BC, transverse-tipped, single-edged and tanged type A arrowheads all occur. All the key artefacts typical of the Nøstvet phase are gone, and blades are more common than microblades. Pieces of polished flint and pottery may occur already at this final stage of the Late Mesolithic. The Kjeøy phase is dated to 4650–3800 BC, but a dating of its onset to c. 4500 cannot be excluded.	Halden lok. 5 Gjølstad R33 Ystehede Rørbekk 1 Torpum 10 Torpum 13 Berget 2 Vestgård 8 Typology/technology/ shoreline/C14

***Figure 6**: Important contributions into the chronology of the Late Mesolithic Kjeøy phase.*

Chronological results from recent, large-scale excavation projects

In this section, I will present technological traits and artefacts typical for their period from the 26 sites that I have examined closely in this study. As previously mentioned, the closures of the present paper are to a large degree based on data from the *Vestfoldbane project* and the *E18 Tvedestrand–Arendal project*. Within these two, 63 Stone Age sites were investigated (Melvold and Persson 2014, Reitan and Persson 2014, Reitan and Sundström 2018). Additionally, results from e.g. the *E18 Bommestad–Sky* and the *E18 Rugtvedt–Dørdal projects* are taken into consideration (see Solheim and Damlien 2013, Solheim 2017a – cf. Fig. 1). All the excavation

projects were carried out ahead of large-scale infrastructural construction works, comprising more than one hundred different sites and virtually all of them shore-bound. As the sites in question were investigated applying the same methods, and the assemblages were consistently classified (Melvold *et al.* 2014, Koxvold and Fossum 2017, Solheim 2017b, Sundström *et al.* 2018), they are well suited for comparative studies. Moreover, the sites are in general well dated, either by means of radiocarbon dating obtained from organic matter from reliable contexts, or based on their height above the present sea level and local shoreline displacement curves (Sørensen *et al.* 2014a, Romundset 2018) (Figs. 7, 9, 11, 13 and 15). The investigated sites cover the entire Mesolithic period and beyond, and the collected data are therefore well suited for enquiries into chronological developments in the long-term. Based on dating results, technological and typological similarities, and the presence of artefacts characteristic for their period, the sites are grouped into different time intervals (three to eleven sites per interval) – periods that deviate from the established chronological scheme (cf. Fig. 2).

The period c. 9500–8300 cal. BC (c. 10,000–9100 BP)

Several sites excavated within the E18 Tvedestrand–Arendal project in Aust-Agder County shed light on this interval (e.g. Darmark 2018a, 2018b, Darmark and Viken 2018, Darmark *et al.* 2018b, Stokke *et al.* 2018, Viken 2018a, 2018b), along with the Vestfoldbane project sites Solum 1 (Fossum 2014a) and Nedre Hobekk 2 (Eigeland 2014) (Fig. 7). The assemblages from most of the sites are flint dominated, and overall the flint is of high quality (Eigeland 2018). Even so, half of the sites listed in Figure 7 yielded considerable quantities of other raw materials – primarily quartz and rock crystal for small tools, along with *metarhyolite* (also termed *ignimbrite*, a dense, volcanic rock, see Fig. 8E) for axes, bearing witness to flexible raw material strategies. The flint technology of the Early Mesolithic was primarily aimed at the production of blades (Fig. 8D), with blades constituting as much as nearly one-third of all collected flints from Kvastad A9 (Darmark 2018c). The blades were mainly produced by direct percussion from one-sided single-platform cores with steep platform angles, but two-sided, dual-platform cores also occur (Fig. 8C; see e.g. Skar and Coulson 1986, Damlien 2016a, Eigeland 2018, cf. Berg-Hansen 2017 for discussion).

Apart from Sagene B4, which is dominated by scrapers (Darmark 2018b), the small-tool inventory from the sites is clearly dominated by projectile points. With microliths included, they constitute an average of 1 % of all flints from the studied sites in this time span (Fig. 7, cf. Jaksland and Fossum 2014, p. 50). Overall, the arrowheads exhibit considerable morphological variation (Fig. 8B, cf. Waraas 2001, p. 103, Jaksland and Fossum 2014, p. 54), but with the Høgnipen points as a highly standardized exception (Darmark and Viken 2018). The examined sites demonstrate a distinct decrease in the ratios of tanged and single-edged points around the middle of the period. Correspondingly, Høgnipen points and lanceolates increase in numbers, reflecting a shift in the projectile point technology. Numerically, microburins constitute a rather marginal category of finds. Still, microburins are identified in eight of the eleven discussed assemblages, albeit with an apparent decrease – making up an average of 0.9 % of the flints from sites older than c. 8600 BC, and only 0.2 % on average on sites younger than c. 8600 BC. Axes (or axe production waste) are represented on all but three sites (Sagene B4, Sagene B6 and Kvastad A9, see Darmark 2018b, 2018c). Flake axes and flake chisels seem to be the only axe type on the earlier sites (Fig. 8A), whereas core axes dominate on certain of the younger sites. One axe of metarhyolite, with parallel sides and extensive thinning on the

ventral side, was recovered at Sagene B1, c. 8800 BC (Viken 2018a, Fig. 2.2.3.7), but this raw material is more common at a later stage – in fact metarhyolite is the dominating axe raw material from the younger Early Mesolithic sites in this study.

Only one Early Mesolithic radiocarbon dating result was obtained from the sites in question (Kvastad A1, see Eskeland 2013, p. 361–362, Stokke *et al.* 2018). The lack of radiocarbon dates is a problem frequently encountered on sites from this phase (Viken and Reitan 2018, cf. Damlien and Solheim 2018, Solheim and Persson 2018).

Key sites and important tendencies in the Early Mesolithic material are summarized in Figure 7.

Site name	Flint ratio	Ratio, blades and microblades	Technological characteristics, artefacts typical of the period	Radiocarbon dates (2 σ)
Sagene B2 (c. 9000 BC)	94.8 %	Blades 8.6 % Microbl. 8.5 %	The flint technology seems to have been focused on the production of blades, mainly from one-sided single-platform cores. Bipolar cores and irregular cores also occur. Although microblades constitute up to 14 % of the flint assemblages, microblades are considered unintended by-products. The tool production seems to rely heavily on flint in the early part of the phase. Some inventories, however, witness that local raw materials were exploited to a considerable degree as early as shortly after 9000 BC, and the sites demonstrate notable individual variation in terms of raw material procurement within the same geographical area. Projectile points are a key artefact group. Tanged and single-edged points dominate the arrowhead material from the older sites, whereas Høgnipen points and lanceolates and diverse microliths are more common on younger sites. Correspondingly, the ratio of microburins decreases through the period. Flint flake axes seem to be in use throughout the Early Mesolithic. Core axes are introduced c. 8600, at the latest, and tend to dominate the axe material after that. Metarhyolithe is applied as an alternative raw material for axes shortly after 9000 BC, but is more common in the last centuries of the EM.	Kvastad A1: 8470–8280 BC/9150 ± 40 BP (Beta-366066, Pinus)
Sagene B4 (c. 9000 BC)	97.9 %	Blades 13.0 % Microbl. 5.9 %		
Sagene B6 (c. 8900 BC)	76.4 %	Blades 10.5 % Microbl. 9.3 %		
Sagene B1 (c. 8800 BC)	42.4 % (?)	Blades 15.9 % Microbl. 4.6 %		
Nedre Hobekk 2 (c. 8600 BC)	58.2 %	Blades 2.1 % Microbl. 0.7 %		
Solum 1 (c. 8600 BC)	94.5 %	Blades 9.5 % Microbl. 0.0 %		
Kvastad A9 (c. 8500 BC)	88.3 %	Blades 29.4 % Microbl. 14.5 %		
Kvastad A4 East (c. 8500 BC)	57.1 %	Blades 7.8 % Microbl. 2.1 %		
Kvastad A1 N/S (c. 8400 BC)	95.4 %	Blades 5.1 % Microbl. 3.8 %		
Kvastad A5-6 N/S (c. 8300 BC)	33.9 % (?)	Blades 24.8 % Microbl. 6.4 %		

Figure 7: *Sites recently excavated within the E18 Tvedestrand–Arendal and Vestfoldbane projects, with traits outlined as characteristic of the Early Mesolithic, c. 9500 (9300)–8300 BC. All radiocarbon dates presented in this paper are obtained using OxCal v4.3 (Bronk Ramsey 2009) and IntCal13 atmospheric curve (Reimer et al. 2013).*

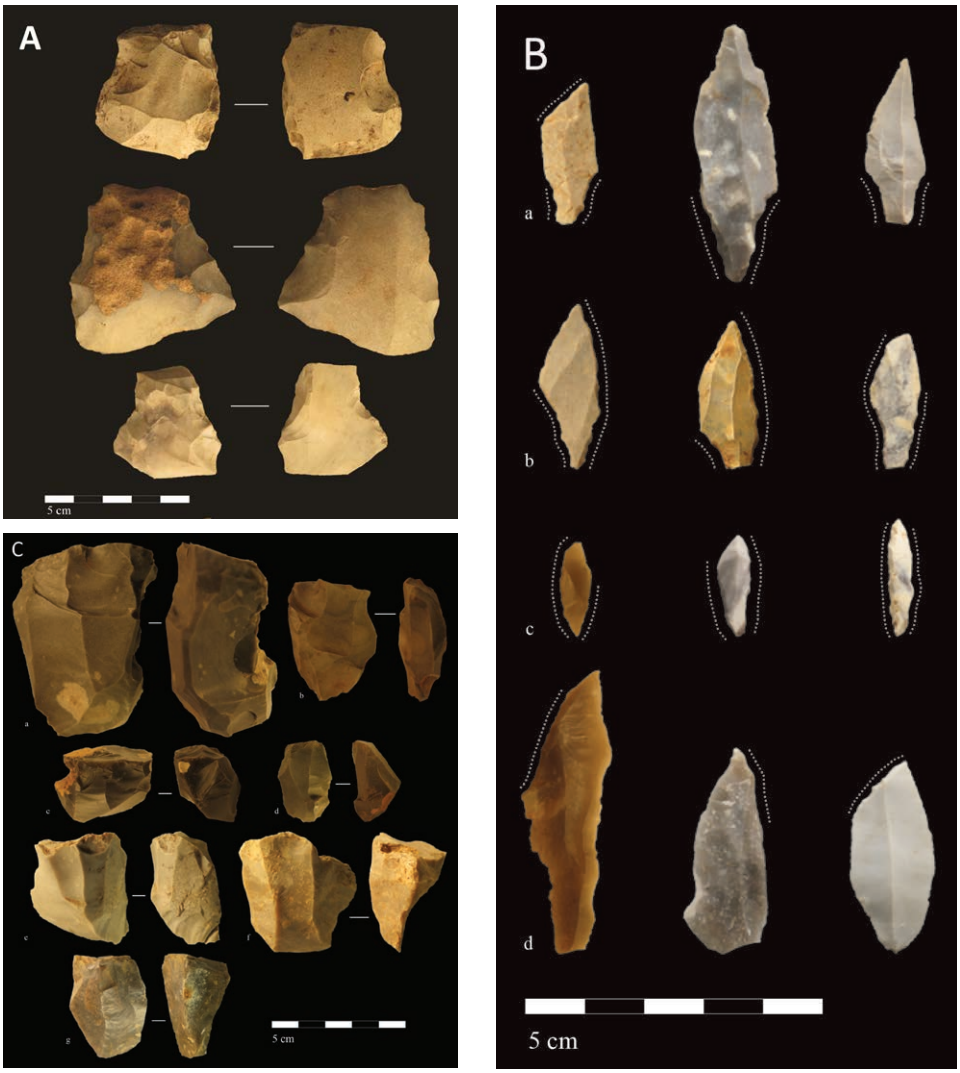

***Figure 8**: Artefacts characteristic of the period c. 9300–8300 BC (cf. Fig. 7): A) Flake axes of flint from Sagene B1 after Viken 2018a, B) Examples of complete tanged points (a), single-edged points (b), Høgnipen points (c) and lanceolate microliths (d) found within the E18 Tvedestrand–Arendal project after Darmark and Viken 2018, C) Flint cores from Sagene 4 (a–d) and Sagene B6 (e–g) after Darmark 2018b, (Fig. 8 contiues on next page)*

***Figure 8**: D) Selection of flint blades from Sagene B1 after Viken 2018a, E) Core axe of metarhyolite from Solum 1 after Fossum 2014a.*

The period c. 8300–7000 cal. BC (c. 9100–8000 BP)

The Vestfoldbane project sites Sundsaasen 1 (Eggen 2014a), Gunnarsrød 7 (Fossum 2014b) and Prestemoen 1 (Persson 2014), along with the E18 Tvedestrand–Arendal site Hesthag C4 (Viken 2018c), date to this period (Fig. 9, for more sites, see e.g. Solheim and Damlien 2013, Solheim 2017a). The assemblages are clearly flint-dominated, and the recorded materials point to a specialised production of both blades and microblades based on conical or semi-conical cores by indirect technique as the prevalent technological concept on the sites (cf. Damlien 2016a, Eigeland 2018). Even so, the core material is commonly dominated by bipolar cores. It is, however, questionable whether all these bipolar cores should actually be considered as cores, or whether some of them may have been used as wedges, planers or other similar tools (for discussion, see Koxvold 2013, p. 122, 130, Solheim 2013, p. 269, Fossum 2014b, p. 186, Persson 2014, p. 207–209, Eigeland 2015, p. 160–161, Damlien and Solheim 2018, p. 348).

Among the fragmented blades, the medial fragments are the most numerous. This may indicate that blades were broken systematically and deliberately, probably in order to produce square or rectangular pieces to be used as knives – 'rulers'. From each of the four sites in Figure 9, two to five typical scalene triangular microliths are recorded (Fig. 10B). No other types of microliths were uncovered, but a number of retouched microblades probably relate to microliths and the use of composite arrows. The microliths seem to have been produced by removal of the percussion bulb by retouching, and no traces of *microburin technique* were identified in any of the four assemblages.

Apart from the flint inventory, all four sites yielded a small number of fragments of grinding slabs. The grinding slabs are to be associated with (mainly) bifacially produced point- or round-butted, pecked adzes or chisels with ground, convex or sometimes hollow edges (Fig. 10D) and rounded/oval cross-sections (Norw. *trinnøkser*, literally meaning 'chubby adzes', and hereafter referred to with this name, cf. for example Bjerck 2008a), and various types of ground shaft-hole hatchets or mace heads made of locally available rock. The shaft-hole hatchet from Hesthag C4 (Fig. 10A) indicates that such tools were introduced around 8000 BC or even slightly earlier (Viken 2018c, see also Fossum 2017 on Hegna Vest 1). It is reasonable to assume that the introduction of these new axe types is linked to the technological shift in the flint industry around 8300BC (cf. Eymundsson *et al.* 2018).

Relevant sites, radiocarbon dates and characteristics of the archaeological record of the period c. 8300–7000 BC are listed in Figure 9.

Site name	Flint ratio	Ratio, blades and microblades	Technological characteristics, artefacts typical of the period	Radiocarbon dates (2 σ)
Hesthag C4 (c. 8000 BC)	96.1 %	Blades 9.2 % Microbl. 5.1 %	The combined production of both blades and microblades from conical cores by indirect pressure is the prevalent technological concept. This marks a distinct break with the previous time period. Still, the core material is dominated by bipolar cores. Knives, scrapers and drill-bits are primarily made of blades/microblades. A small number of microliths (scalene triangles) is recorded from all the four sites, but without traces of microburin technique. Chubby stone adzes and shafthole hatchets with ground, convex edges and associated grinding slabs are introduced around 8000 BC at the latest – seemingly with a slight increase through the period. Thoroughly ground, hollow-edged stone adzes and chisels are in use, too, predominantly in the earlier stage of this period. Core axes of flint and metarhyolite are still in use.	Hesthag C4: 8170–7730 BC/8800 ± 40 BP (Beta-448123, Pinus) Prestemoen 1: 7795–7590 BC/8671 ± 45 BP (Ua-45176, Corylus, nutshell), 7740–7575 BC/8620 ± 45 BP (Ua-45177, burnt bone, indet.), 7720–7545 BC/8593 ± 46 BP (Ua-45178, Corylus, nutshell)
Sundsaasen 1 (c. 7800 BC)	97.5 %	Blades 0.7 % Microbl. 1.6 %		
Prestemoen 1 (c. 7600 BC)	93.6 %	Blades 2.1 % Microbl. 4.3 %		
Gunnarsrød 7 (c. 7500 BC)	99.1 %	Blades 3.5 % Microbl. 2.2 %		

***Figure 9**: Recently excavated sites with inventory characteristic of the period c. 8300–7000 BC.*

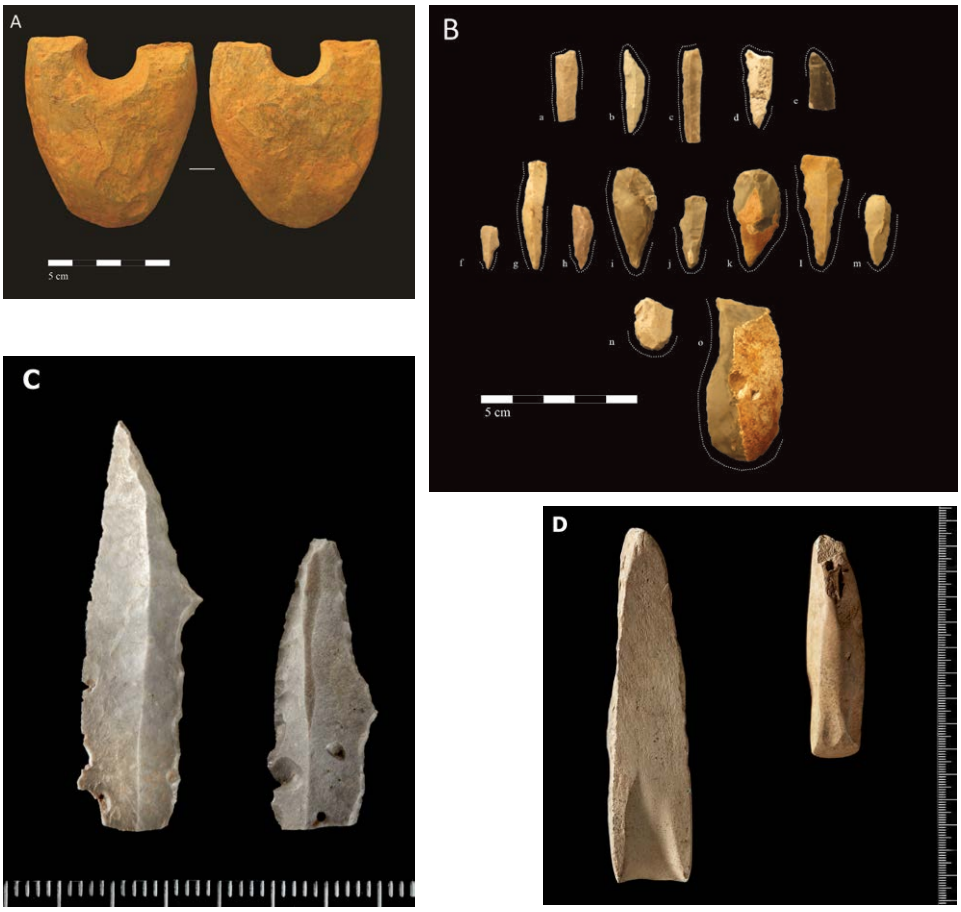

***Figure 10**: Artefacts characteristic of the period c. 8300–7000 BC (cf. Fig. 9): A) Fragmented shaft-hole hatchet from Hesthag C4, B) Scalene triangles (a–e), borers (f–m) and scrapers (n–o) from Hesthag C4, C) Barbed points from Hovland 3 after Solheim and Færø Olsen 2013, D) Hollow-edged stone adze (left) and reworked chisel, originally hollow-edged (right), from Hegna Vest 1 after Fossum 2017.*

The period c. 7000–5600 cal. BC (c. 8000–6700 BP)

For this previously little explored interval the comprehensive assemblage from the well-dated site Langangen V. 1 (Melvold and Eigeland 2014) is central, but Gunnarsrød 6 (Carrasco *et al.* 2014), Gunnarsrød 4 (Reitan 2014a) and Gunnarsrød 2 (Reitan and Fossum 2014) also shed light on this period (Fig. 11).

Overall, the investigated sites demonstrate a distinct decrease in the flint ratio compared to sites from the preceding period (Fig. 9), along with a corresponding increase in the amount of adze-related rock material (cf. Reitan 2016, Table 9). The flint industry is still oriented towards the production of both blades and microblades from the same conical or semi-conical cores (Fig. 12C), but the share of microblades increases after 7000 BC. However, the core material is dominated by bipolar cores to a larger degree than earlier, for example at Gunnarsrød 6 (cf. Jaksland 2001, p. 35). No typical handle cores are recorded from these sites, but a small

number of microblade cores from both Brunstad (see below) and Gunnarsrød 6 exhibit traits similar to narrow-faced cores from the Baltic region (see Carrasco *et al.* 2014, Fig. 13.7 d–f, cf. Hertell and Tallavaara 2011). The assemblages do not include any microliths – not even from the rich Langangen V.1, which demonstrates repeated occupations between c. 7000 and 6500 BC (see Fig. 11). The use of what can be designated as 'informal microliths' (microblades with retouch along one or either side), on the other hand, continues throughout the period in question (cf. Jaksland 2001, Hernek 2005, p. 247–248).

Knives of sandstone are a significant novelty of this interval (Fig. 12D). Another and even more striking feature of this phase is the number of chubby adzes and the associated waste material (Fig. 12A). No adzes from this interval can be classified as Nøstvet adzes (Fig. 14A). The measurements and the morphological traits of the chubby adzes vary somewhat, but the differences do not appear to rely on chronology. The adzes are normally point-butted, and the cross-sections normally rounded or oval, but some specimens exhibit a D-shaped cross-section with a plane ventral surface, the latter type likely manufactured from loose blocks or nodules from moraines. In addition, a few thin chisels with pointed oval cross-sections are recorded from several of the sites listed in Figure 11, but not from sites from other periods (Fig. 12B).

The data from the recent investigations of three adjacent sites at Brunstad south of Tønsberg, Vestfold County, including a stone-lined primary grave dated to c. 5900 BC, are presented elsewhere (Reitan and Schülke 2018, Reitan *et al.* 2019, Schülke *et al.* 2019) and are hence not included in Figure 11. Even so, the Brunstad sites deserve brief mention here, as they shed important light on this period. A total of 15 radiocarbon dates from Brunstad covers the time-span between c. 6400 and 5600 BC (Reitan *et al.* 2019, Fig. 7). The dates witness to repeated occupations in what was then a shallow bay on a small island. The dating results cover the first two parts of the Nøstvet phase, according to the established chronology of the region (see Fig. 2, Glørstad 2004). Typical chubby adzes were recorded from all three sites, whereas no Nøstvet adzes were found, not even on the youngest of the three sites, which, according to the altitude, dates to c. 5800–5600 BC. Even though the three Brunstad sites cover a period of up to 800 years, the assemblages from them can be characterized as typologically and technologically homogeneous. The similarities between Brunstad and the Vestfoldbane project sites from 7000–5600 BC are apparent.

Sites and assemblages epitomizing the period c. 7000–5600 BC are presented in Figure 11.

Site name	Flint ratio	Ratio, blades and microblades	Technological characteristics, artefacts typical of the period	Radiocarbon dates (2 σ)
Langangen V. 1 (7000–6500 BC)	73.0 %	Blades 0.4 % Microbl. 3.7 %	The production of blades/ microblades from conical/ semi-conical cores is the dominating technological concept. Even so, the core material, here too, is dominated by bipolar cores, and to a larger extent than from sites older than 7000 BC. Typical handle cores are not recorded from any of the sites in this table. Assemblages from the later stage of this interval, however, include certain small microblade cores that can be designated as narrow-faced. The production of microblades increases significantly compared to the previous time period. Yet, small-tools like drill-bits, scrapers and knives are primarily made of blades. The assemblages from this interval do not encompass any microliths. The flint ratio is lower than in the previous period. This relies on the distinct increase in stone adze-related production waste and the occasionally high numbers of chubby adzes with round or oval cross-section. Additionally chisels with elliptical cross-section occur – a type not recorded from other parts of the Mesolithic. Knives of sandstone with ground edges are a novelty in this time period, whereas the characteristic Nøstvet adze with its three-sided cross-section is not yet introduced.	Langangen V. 1: 7130–6702 BC/8030 ± 55 BP (TRa-4117, *Pinus*), 7063-6711 BC/8005 ± 45 BP (TRa-4118, *Salix/Populus*), 7037–6692 BC/7945 ± 45 BP (TRa-4121, *Betula, Salix/Populus*), 7025–6606 BC/7875 ± 45 BP (TRa-4120, *Corylus*), 7023–6601 BC/ 7870 ± 45 BP (TRa-4114, *Betula, Sorbus*), 7003–6592 BC/ 7850 ± 45 BP (TRa-4119, *Betula, Corylus*), 6750–6501 BC/ 7800 ± 45 BP (TRa-4116, *Corylus*), 6692–6506 BC/ 7795 ± 40 BP (TRa-4122, burnt antler), 6685–6505 BC/ 7785 ± 40 BP (TRa-1994, burnt bone, *indet.*), 6820–6461 BC/ 7780 ± 70 BP (TRa-2243, *Pinus*), 6651–6484 BC/ 7760 ± 40 BP (TRa-1995, burnt bone, *indet.*), 6644–6485 BC/ 7745 ± 35 BP (TRa-4123, burnt antler), 6645–6476 BC/ 7740 ± 45 BP (TRa-4115, *Corylus*) Gunnarsrød 4: 6209-6006 BC/7210 ± 38 BP (UBA-19158, *Pinus*), 5963-5732 BC/6941 ± 36 BP (UBA-19159, *Betula*)
Gunnarsrød 2 (7000–6400 BC)	91.0 %	Blades 2.9 % Microbl. 5.8 %		
Gunnarsrød 6 (6300–6000 BC)	60.7 %	Blades 0.7 % Microbl. 4.8 %		
Gunnarsrød 4 (6200–5700 BC)	72.2 %	Blades 3.7 % Microbl. 10.5 %		

***Figure 11**: Recently excavated sites with inventory characteristic of the period c. 7000–5600 BC (cf. Reitan et al. 2019 on the Brunstad sites, c. 6400–5600 BC). Note that the site Langangen V. 1 originally was published under the name Langangen Vestgård 1. The site name is here abbreviated to avoid confusion with other previously excavated and published Vestgård sites at Svinesund (see Glørstad 2004). This also applies to other and younger Langangen Vestgård sites mentioned in this paper.*

***Figure 12**: Artefacts characteristic of the period c. 7000–5600 BC (cf. Fig. 11): A) Chubby adzes of diabase from Gunnarsrød 6 after Carrasco et al. 2014, B) Stone chisel with elliptic cross-section from Gunnarsrød 2 after Reitan and Fossum 2014, C) Conical microblade core of flint from Gunnarsrød 4 after Reitan 2014a, D) Sandstone knives from Brunstad lok. 25 after Reitan et al. 2019.*

The period c. 5600–4500 cal. BC (c. 6700–5650 BP)

The sites Vallermyrene 4 (Eigeland and Fossum 2014) and Krøgenes D2 (Mansrud *et al.* 2018) are representative of this period, arguably also Vallermyrene 1A (Reitan 2014b). The comprehensive inventory retrieved at Vallermyrene 4 encompasses all the typical artefacts of the sub-phase occasionally referred to as 'classic Nøstvet' (Fig. 14) – thick flake borers, handle cores, sandstone knives, as well as numerous flint microblades and stone Nøstvet adzes and associated grinding slabs (e.g. Glørstad 2004, Jaksland 2005). The assemblages reflect an extensive production of microblades mainly based on handle cores (Fig. 14B), as demonstrated by Vallermyrene 4 and Krøgenes D2 (Fig. 13, see however Eigeland 2018, p. 520–521 and Mansrud *et al.* 2018 for discussion of possible regional differences in the core material). The production of wider blades, on the other hand, has not been a part of the reduction strategy

(Eigeland 2015, p. 376). Additionally, small flint tools were made from flakes, not blades, throughout this period.

The number of rock finds in the assemblages is striking, constituting as much as 71 % of the total c. 50,000 finds unearthed at Vallermyrene 4 (Fig. 13). The varied raw material composition is a characteristic trait of this interval, and large numbers of rock adzes are recorded from the sites (Jaksland 2005, Glørstad 2010, see e.g. Nordqvist 2000b and Johansson 2006 on Margreteberg and Bjällvarpet, respectively, for parallel, adze-rich sites from the same phase in southwest Sweden). The chubby stone adze is now abruptly replaced by the Nøstvet adze (Fig. 14A). Based on analyses of the production waste material, Eigeland and Fossum (2014) have concluded that approximately 200 Nøstvet adzes were produced at Vallermyrene 4, although the number of adzes actually retrieved on the site is significantly lower (cf. Mansrud *et al.* 2018 on calculations for Krøgenes D2). The material from Vallermyrene 1A suggests that the adze production decreases towards the end of the period. An almost complete Nøstvet adze was recorded from Vallermyrene 1A (Reitan 2014b, Fig. 4.6), whereas no adze and very little rock production waste were collected from the slightly younger Vallermyrene 1B.

Diagnostic artefacts, technological trends and key sites representative of the period c. 5600–4500 BC are found in Figure 13.

Site name	Flint ratio	Ratio, blades and microblades	Technological characteristics, artefacts typical of the period	Radiocarbon dates (2 σ)
Vallermyrene 4 (5500–4800 BC)	28.7 %	Blades 0.3 % Microbl. 8.5 %	The technological concept is clearly oriented toward the serial production of microblades, and not wider blades, from handle cores. There are however tendencies to an increased production of blades towards the end of the time period. In addition to handle cores other platform cores and irregular cores occur, as well as certain bipolar cores. The ratio of secondarily worked flint is low. Among the small-tools of flint scrapers and drill-bits with a distinct three-sided cross-section are numerous. These are normally made of flakes, not blades. Knives of sandstone are still a central category. A comprehensive rock material debris and high numbers of Nøstvet adzes characterize the period. The rich finds of locally available rock indicate a specialized adze production and to a far larger degree than before 5600 BC. The selection of raw materials for the Nøstvet adzes seems more varied than on earlier sites in the same area. The chubby adzes are no longer in use, and the pecking of the adzes ceases. The amount of adze-related rock waste seems to decrease at the final stage of the period.	Vallermyrene 4: 5541–5340 BC/6381 ± 37 BP (Ua-45170, burnt bone, mammal) 5470–5307 BC/6489 ± 50 BP (Ua-45169, burnt bone, mammal), 5296–5040 BC/6197 ± 40 BP (Ua-45172, *Pinus*), 5203–4842 BC/6067 ± 41 BP (Ua-45171, *Pinus*) Krøgenes D2: 5375–5080 BC/6297 ± 44 BP (Ua-50980, *Pinus*), 5317 – 5081 BC/6260 ± 30 BP (Beta-448128, *Alnus*), 5213–4956 BC/6132 ± 45 BP (Ua-50982, *Pinus*) Vallermyrene 1A: 4712–4537 BC/5770 ± 35 BP (Ua-45182, *Pinus*), 4691–4501 BC/5748 ± 35 BP (Ua-45181, *Pinus*)
Krøgenes D2 (5300–5000 BC)	47.2 %	Blades 2.1 % Microbl. 13.8 %		
Vallermyrene 1A (4700–4500 BC)	85.6 %	Blades 2.7 % Microbl. 3.3 %		

***Figure 13**: Recently excavated sites with inventory characteristic of the period c. 5600–4500 BC.*

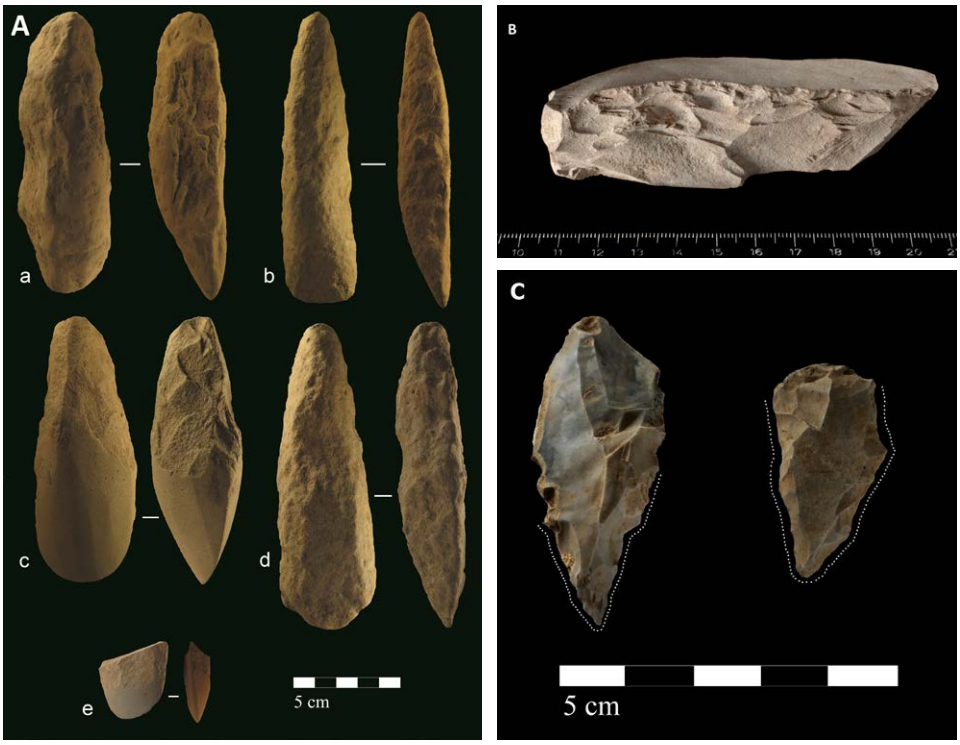

***Figure 14**: Artefacts characteristic of the period c. 5600–4500 BC (cf. Fig. 13): A) Nøstvet type adzes of eroded hornfels (a, b, d) and igneous rock, probably diabase or basalt (c, e), from Krøgenes D2 after Mansrud et al. 2018, B) Flint handle core preform from Vallermyrene 4 after Eigeland and Fossum 2014, C) Flint borers with three-sided cross-sections from Vallermyrene 4, photo: G. Reitan / Museum of Cultural History.*

The period c. 4500–3900 cal. BC (c. 5650–5100 BP)

Evidence for the chronological development in the final stage of the Late Mesolithic is provided by the sites Vallermyrene 1B (Reitan 2014b) and Langangen V. 3 (Eggen 2014b), along with the northern part of Langangen V. 5 (the latter is not included in Fig. 15 due to its multi-phased inventory, see Reitan 2014c). The collected material from the first two of these sites points towards a consistent handle-core-based production of microblades. Even so, the production of wider blades was an element in the technological strategy, as suggested by the Vallermyrene 1B material (Fig. 15), where the systematic selection of wide and thick blades is traceable among the scrapers (Fig. 16C).

Arrowheads are a prominent tool category in these last centuries of the Mesolithic, and transverse-tipped, single-edged and tanged varieties occur. The transverse arrowheads dominate the projectile point material, usually made of flakes (Fig. 16B); the other two main types are generally made of narrow blades or blade-like flakes.

The body of adze-related material from this period is scarce compared to the preceding period (see Reitan 2016, Table 9). One stone adze is recorded from Langangen V. 3, but the specimen is heavily eroded and difficult to classify. Within a small area on the elevated, northern part

of Langangen V. 5, and isolated from other both earlier and younger concentrations of finds, microblades, blades and a transverse arrowhead, inter alia, were collected, along with two extensively ground stone adzes with oval cross-sections (Fig. 16A). The adzes were located next to each other and adjacent to two hearths, both radiocarbon dated to c. 4400 BC (Fig. 15, Reitan 2014c). The two adzes share several characteristics both in terms of morphological traits and in terms of raw material, but they do not exhibit any typical Nøstvet adze traits. Nor do they display any features normally associated with Neolithic varieties, such as four-sided cross sections or distinct side faces.

Important traits of the archaeological record from the period c. 4500–3900 BC are summarized in Figure 15.

Site name	Flint ratio	Ratio, blades and microblades	Technological characteristics, artefacts typical of the period	Radiocarbon dates (2 σ)
Vallermyrene 1B (4300–4100 BC)	97.7 %	Blades 3,0 % Microbl. 3.3 %	The technological strategy is focused on the production of microblades, primarily based on handle cores. However, the numbers of other types of platform cores increase, whereas the bipolar cores become fewer than in the preceding period, a development probably linked to an increased blade production. Blades now seem to be preferred for small tools like knives and scrapers, and borers made of flakes are no longer in use. However, arrowheads constitute the critical novelty of this interval. Transverse arrowheads dominate, but single-edged points and tanged points of type A also occur. As a rule the transverse-tipped arrowheads are made of flakes, the two other arrowhead types of small blades or blade-like flakes. The flint ratio increases substantially, whereas stone adzes become notably fewer. The relatively few recorded adzes differ clearly from the Nøstvet adzes both in raw material and morphology in addition to being more extensively ground. The use of sandstone knives ceases.	Vallermyrene 1B: 4331–4063 BC/5373 ± 34 BP (Ua-45180, *Betula*) Langangen V. 3: 4876–4726 BC/5910 ± 10 BP (TRa-2248, *Pinus*), 4348–4057 BC/5400 ± 55 BP (TRa-2246, *Pinus*), 4323–4003 BC/5325 ± 40 BP (TRa-2247, *Pinus*), 4323–4003 BC/5325 ± 40 BP (TRa-2250, *Betula*), 4322–4005 f.Kr/5325 ± 45 BP (TRa-2249, *Betula*) Langangen V. 5 North: 4575–4465 BC/5695 ± 50 BP (TRa-2255, *Pinus*), 4520–4405 BC/5645 ± 45 BP (TRa-2254, *Betula*, *Salix/Populus*)
Langangen V.3 (4300–4000 BC)	99.7 %	Blades 0.4 % Microbl. 2.6 %		

Figure 15: *Recently excavated sites with inventory characteristic of the period c. 4500–3900 BC.*

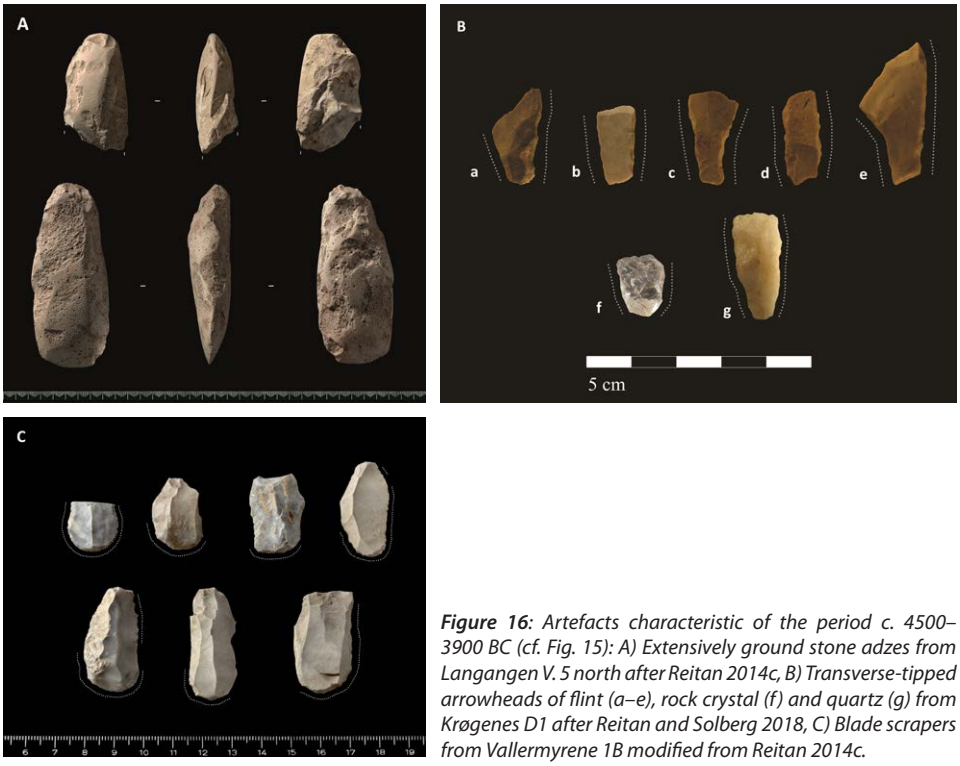

***Figure 16**: Artefacts characteristic of the period c. 4500–3900 BC (cf. Fig. 15): A) Extensively ground stone adzes from Langangen V. 5 north after Reitan 2014c, B) Transverse-tipped arrowheads of flint (a–e), rock crystal (f) and quartz (g) from Krøgenes D1 after Reitan and Solberg 2018, C) Blade scrapers from Vallermyrene 1B modified from Reitan 2014c.*

C. 3900 cal. BC (c. 5100 BP) – the onset of the Neolithic

It is beyond the scope of this paper to go into detail about the Neolithic period. Nevertheless, it is appropriate to mention some important aspects of the two Early Neolithic Vestfoldbane project sites Langangen V. 5 and Langangen V. 6, as they provide valuable insights into the initial part of the Early Neolithic period and consequently the end of the Late Mesolithic. The assemblages from the two Langangen sites together comprise approximately 21,000 finds, and the age of each site is determined by a series of radiocarbon dating results to c. 3950–3700 BC (Reitan 2014c, 2014d).

The production of blades has been the predominant goal of the flint reduction on both sites. Handle cores are no longer in use, and the strategic production of microblades has ceased. Furthermore, the two sites demonstrate a striking increase in the share of flints with secondary working in the Early Neolithic – 3.9 % at Langangen V. 5 and 4.7 % at Langangen V. 6 (cf. 4.2 % of in all c. 46,000 finds at the contemporary site Vestgård 6 at Svinesund, see Jaksland and Tørhaug 2004). In comparison, the average ratios of flints with secondary working from the Late Mesolithic sites in Figures 13 and 15 are 1.0 % and 1.7 %, respectively. The arrowheads from the Early Neolithic are of the same main types as those in the final Mesolithic stage, but they increase significantly in numbers. Moreover, the arrowheads are more often produced on the base of wider and more regular blades. Bipolar cores constitute a half of all cores (for the fabrication of transverse arrowheads?), but the increased production of blades can be associated with different platform cores.

Considering the uncertainties regarding the extent and the character of farming in the Early Neolithic (for discussions, see e.g. Østmo 1988, 1998, Mikkelsen 1989, Prescott 1996, Glørstad 1998a, 2002, 2004, Reitan *et al.* 2018), I see novelties in the archaeological record, i.e. polished flint and stone axes/adzes with four-sided cross-sections and pottery, as the prime Early Neolithic markers. Complete polished flint axes are not recorded from any of the two Langangen sites. However, small pieces of polished flint were retrieved from both of them, demonstrating that flint axes were in use and secondarily used as flint resources for small tools. Ground stone axes and adzes with distinct four-sided cross-sections were also unearthed at both sites. These axes and adzes clearly differ from Late Mesolithic types. Besides, more than a thousand potsherds from at least six different vessels of the funnel beaker type were collected at Langangen V. 6 (Reitan 2014d). Assemblages with similar characteristics were recovered from a number of sites examined within the Svinesund project – sites dated to the same period as the two Langangen sites (Glørstad 2003, Jaksland and Tørhaug 2004, Johansen 2004).

Correcting the map – newly identified chronological patterns in a wider perspective

The Early Mesolithic – fluctuations in the projectile point and axe material

Until recently, the low number of excavated Early Mesolithic sites has hampered attempts to address chronological questions on local terms (Fig. 2). Consequently, previous Norwegian studies of the Early Mesolithic have to a large degree focused on cultural affinities with southern Scandinavian and continental finds (e.g. Waraas 2001, Fuglestvedt 1999, 2007, Bjerck 2008a, cf. Damlien 2016a, p. 39–42, Berg-Hansen 2017, p. 21–40). This situation has now changed, mainly as a result of the investigations within the E18-related projects in Brunlanes, Vestfold County, and in Tvedestrand–Arendal, Aust-Agder County, with their 8 and 14 excavated Early Mesolithic sites respectively (see Jaksland and Persson 2014, Reitan 2018b). In addition to the sheer number of sites and the time-span they cover, the value of the excavated data is amplified by precise and well-dated, local shoreline displacement curves, especially in the Tvedestrand–Arendal area (Romundset 2018, cf. Sørensen *et al.* 2014a, 2014b). Admittedly, not every single site encompasses quantitative qualities suitable for comparative analyses. There are also considerable individual variations between contemporary sites, potentially owing to differing site functions (Viken 2018d, cf. Eigeland 2018). So far, no investigated site in the region can be convincingly dated any earlier than the Preboreal oscillation, c. 9300–9200 BC (Glørstad 2013, p. 58, Berg-Hansen 2017, p. 30–36 with references, Damlien and Solheim 2018, p. 339, cf. Björck *et al.* 1997 and Mangerud and Svendsen in this volume).

Certain fluctuations in the Early Mesolithic material recorded from the E18 Brunlanes project were identified by Jaksland and Fossum (2014) as being chronologically dependent (Fig. 3). The investigated Brunlanes sites cover a period of approximately 400 calendar years, ranging from c. 9200–8900 to 8800–8500 BC – the Pauler sequence (Jaksland 2014, p. 39–40). Two quantitative trends are particularly prominent in this material. Firstly, while single-edged points dominate the projectile point material in the early part of the Pauler-sequence, over time the share of single-edged points decreases distinctly. Secondly, and concurrently with the decrease in single-edged points, the proportion of lanceolate microliths increases. It has been suggested that the latter trend is linked to an increased use of microburin technique (Jaksland and

Fossum 2014, p. 57). The number of Høgnipen points increase during the Pauler-sequence, too, but less markedly than the lanceolates. Further observations can be made based on the Brunlanes material. First, that the flake axe is the only axe type in use throughout the first half of the ninth millennium BC; second, that the sides of the axes become increasingly parallel and that flake chisels are more common on the younger sites (Jaksland and Fossum 2014, p. 57–58). The changes identified in the Brunlanes projectile point material are consistent with trends previously observed for the time-span c. 8900–8200 in southern and southwestern Norway (e.g. Bang-Andersen 1990, Ballin 1999a, 2004, Fuglestvedt 2007).

Moving on to the E18 Tvedestrand–Arendal material, the blade and core material seems to confirm that the production technique remains the same throughout the Early Mesolithic (Eigeland 2018, cf. Damlien 2016a, p. 389). But the same 'microlithisation development' is evident in the projectile point material, most likely expressing a higher dependency on composite projectile point designs, including Høgnipen points as tips and microliths as (unilateral?) elements in slotted bone points or wooden shafts (Darmark and Viken 2018). However, as underlined by Jaksland and Fossum (2014, p. 56), tanged points/single-edged points and lanceolate microliths are not mutually exclusive – both types occur throughout the Early Mesolithic (cf. Darmark and Viken 2018, Table 3.8.2). It therefore seems reasonable to conclude that this shift can be designated as a gradual one. To judge from the E18 Tvedestrand–Arendal site material, the time frame during which these changes appear can be narrowed down to c. 8800–8600 BC.

The axe material from the E18 Tvedestrand–Arendal sites also seems to reflect certain chronologically dependent changes, namely a gradual increase in flake chisels and core axes, although flake axes/chisels occur throughout the Early Mesolithic. Core axes, on the other hand, are only recorded from sites younger than c. 8700–8600 BC. Overall, the available material also reflects an increased use of local non-flint raw materials in the same period.

At present, it may be disputable whether these trends in the recently excavated material – outlined above – really justify a division of the Early Mesolithic into two sub-phases. If they do, it is reasonable to suggest a dating of the transition to c. 8700–8600 BC. It is anticipated that investigations of further sites from this period may contribute to a clarification of this.

As for the end of the Early Mesolithic and the introduction of the conical core pressure blade technology, Damlien (2016a, p. 387–392, cf. M. Sørensen *et al*. 2013) has suggested a backdating of the Early Mesolithic/Middle Mesolithic transition in the Oslo Fjord area to c. 8400 BC. Sites from the period between c. 8500 and 8000 BC excavated within the E18 Tvedestrand–Arendal project (Fig. 9, see Darmark *et al.* 2018b, Stokke *et al.* 2018, Stokke and Reitan 2018, Viken 2018b) may however suggest that Damlien's proposed dating of the transition is somewhat too early, at least regarding the southern parts of the region. Besides, relatively few sites from the Early/Middle Mesolithic transitional phase have been investigated and dated precisely. Altogether, the presently available data suggest that c. 8300 is a reasonable dating of the Early/Middle Mesolithic transition.

The Middle Mesolithic – microliths as chronological markers?

Microliths only constitute a marginal share of the assemblages from the Middle Mesolithic sites included in the present study (Fig. 9). This applies also to other investigated sites from the same period in the region (Mansrud 2013, p. 76; Solheim 2013, p. 269–272, Fig.

17.6). Even so, microliths have been a key tool category in discussions of chronology in the Middle Mesolithic, as shown in Figure 9 (e.g. Ballin and Jensen 1995, Ballin 1995, 1999a, 2000, Jaksland 2001, Mansrud 2013, Solheim 2013). It has previously been suggested that microliths were an integrated part of the lithic industry up until the transition to the Late Mesolithic Nøstvet phase, c. 6350 BC according to the established chronology. This was based on the presence of microliths in assemblages from sites investigated at Lista in Farsund, Vest-Agder County, in southernmost Norway (Figs. 1 and 4): numerous scalene triangles as well as conical blade- and microblade cores were retrieved from two sites, *R17* and *R21/22*. A burnt hazelnut shell collected from the layer of finds on R17 was radiocarbon dated to 6820–6450 BC (7770 ± 75 BP, Ua-3556) (Ballin and Jensen 1995, p. 61–62). This led Ballin (1999a) to assume a direct link between this single dating result and the microliths from both R17 and R21/22. Instead, I would claim that the dating of the microliths from both sites is far from certain, not least owing to the fact that the relative sea level history of the Farsund area shows a very modest land uplift in comparison to areas further north (see Romundset *et al.* 2015). As a consequence of the small changes and slowstands in the sea level, terraces suitable for marine oriented occupation have repeatedly, or over long periods, been situated adjacent to the shoreline. As a result, the archaeological finds on such sites are a mix from different parts of the Stone Age, representing an interpretational problem, surely relevant also to R17 and R21/22 (e.g. Ballin and Jensen 1995, Reitan and Berg-Hansen 2009, Reitan 2010).

With reservations about potential differences between contemporary sites in the Lista and the Oslo Fjord areas, Ballin's (1999a) closures concerning the microlith production are not consistent with tendencies identified in recently excavated assemblages from the counties of Vestfold and Telemark. For instance, the site Langangen V. 1 (Fig. 11, see Melvold and Eigeland 2014) fits temporally very well into Ballin's suggested Middle Mesolithic B/ 'the Lundevågen phase' (c. 7500–6350 BC, see Fig. 4). Based on comprehensive finds from Langangen V. 1, encompassing a wide range of tools, the assemblage is likely typical of the time frame c. 7000–6500 BC. From a technological point of view, Melvold and Eigeland (2014) have characterized the Langangen V. 1 flint core and blade inventory as distinctly Middle Mesolithic. Yet, no microliths are recorded from the site. This means that one of the artefacts designated as characteristic of the period is lacking. Moreover, knives made of thin sandstone plates with ground edges are among the finds – a tool type commonly acknowledged as characteristic of the Late Mesolithic Nøstvet phase (Figs. 11 and 13, see Jaksland 2005). However, Langangen V. 1 lacks other typical Nøstvet phase finds, such as handle cores and Nøstvet adzes (Fig. 14). As a result, the Langangen V. 1 material can represent a transitional phase between the Middle Mesolithic/phase 2 and the Late Mesolithic Nøstvet phase/phase 3 (cf. Fredsjö 1953, p. 89–97, Kindgren and Åhrberg 1999, Nordqvist 1999, 2000a on what has been labelled *the Enerklev phase* in western Sweden).

In the collected material from the four 8300–7000 BC sites analysed in this study (Fig. 9), scalene triangles produced without microburin technique clearly dominate the microlith material. The sites Gunnarsrød 7 in Porsgrunn municipality and Skutvikåsen 3 in Skien municipality, both in Telemark County, are the youngest sites I know of with distinct microliths present, both shoreline dated to c. 7300–7100 BC (see Fossum 2014c and Ekstrand 2013, respectively). The youngest site that I presently know of where a microburin (one single) has been identified is Lågerødåsen in Sandefjord municipality, Vestfold, dated on the base of a new shoreline displacement curve suggested by Persson (2008) to c. 7400–7000 BC (Eymundsson

2014). Overall, the find material analysed in the present study at hand towards a termination of the use of *typical* microliths approximately 7000 BC (cf. Helskog *et al.* 1976, p. 28, for discussions on 'informal microliths', see e.g. Bjerck 2008a, Mansrud 2013, p. 77–78, with references). This conclusion is in keeping with a previously outlined tendency for the same time frame in the Oslo Fjord area (see Mansrud 2013).

The adzes of the Middle Mesolithic and the Late Mesolithic Nøstvet phase

The assemblages from the sites listed in Figure 9 share many important traits – traits also identified in other assemblages from the same time frame across southeast Norway (e.g. Jaksland 2001, Solheim and Damlien 2013). Together these draw an ever-clearer picture, which is largely in line with the one outlined by Jaksland (2001) for the Oslo Fjord area (see Fig. 4): the combined production of blades and microblades from the same conical or semi-conical cores persists throughout the whole period, whereas the use of barbed points and the microburin technique terminates approximately 7500 BC. Chubby adzes, shaft-hole hatchets/mace heads and associated sandstone grinding slabs are introduced at an earlier stage than previously assumed – already around 8000 BC at the latest, as shown by Hesthag C4 (Viken 2018c, cf. Jaksland 2001, p. 67, Solheim 2013, p. 274). This development is likely closely linked with other technological changes around 8300 BC (see Damlien 2016a, Eymundsson *et al.* 2018). The amount of stone adze-related material, albeit scarce, is consistent throughout this period of just over one thousand years.

In the centuries after 7000 BC, the chubby adze is clearly the dominant adze type, but the amount of adze-related material now constitutes a far bigger share of the collected assemblages (Reitan 2016, Table 9). Sites in Vestfold and Telemark, especially, demonstrate that adze production was largely based on a dark brown to blackish diabase, bearing witness to a well-established adze tradition including strategic raw material procurement in the area. This tradition thus transcends the established transition between the Middle Mesolithic and the Late Mesolithic Nøstvet phase (cf. Glørstad 2004). A reassessment of the collected stone adze material from the site Trosterud 1 in Vestby municipality, Akershus County, strongly challenges Berg's (1997) asserted introduction of the Nøstvet adze c. 6600 BC (Fig. 5, see Reitan 2016, note 5 for recalibrated dating results from Trosterud 1). Of the 22 complete or partly fragmented adzes from Trosterud 1, Berg classified 16 as Nøstvet adzes. In my re-evaluation of this material, only chubby adzes and production debris from such were identified – none of them could be classified as Nøstvet adzes. The finds from the Vestfoldbane project along with the Brunstad assemblages demonstrate that the chubby adzes are not replaced by the Nøstvet adze until c. 5600 BC. This shift in the adze technology can be characterized as abrupt, and it takes place simultaneously on both sides of the Oslo Fjord (e.g. Glørstad 2004). In other words, Nøstvet adzes occur only within a period of just over one thousand years in the latest part of the Nøstvet phase as it is delimited in the established chronology – that is, in the period commonly referred to as 'classic Nøstvet'.

What defines the Late Mesolithic Nøstvet phase?

Ever since Mikkelsen's (1975a) study it has been widely agreed that the beginning of the Nøstvet phase can be dated to c. 6350 BC (Fig. 2). As shown in Figure 5, however, different scholars disagree on what they consider as the major markers of the onset of the phase. Certain

scholars have focused on the discontinued use of microliths at the transition between the Middle Mesolithic and the Late Mesolithic Nøstvet phase (Ballin 1995, Glørstad 2004), while others have pointed to the introduction of the Nøstvet adze (Berg 1997) or the sandstone knife (Jaksland 2005) as the main markers. The introduction of the handle core has also been highlighted by some (Mikkelsen 1975a, Lindblom 1984, Ballin 1998, Jaksland 2001).

As demonstrated, excavations carried out in recent years indicate that the Nøstvet adze was not introduced until approximately 5600 BC – that is, some 700–800 years after the beginning of the Nøstvet phase according to the established fixation of the transition, whereas typical microliths are discontinued equally far ahead of the established transition, c. 7000 BC. In fact, there is not one single, well-defined tool type that is unique for the Nøstvet phase, which does not also occur in other parts of the Mesolithic (Jaksland 2005, p. 39).

Glørstad (2004) points out a certain continuation from the Middle Mesolithic and into the earliest part of the Nøstvet phase, in, inter alia, the material of blades and chubby adzes. At the same time, he stresses that there are considerable variations over time within the defined Nøstvet phase, too. In this connection, it is worthwhile to take a closer look at the site Torpum 1 in Halden municipality, Østfold County, excavated within the Svinesund project (Johansen 2003, Glørstad 2004). Based on the height above the present sea level and typological traits, including a few handle cores, and drawing on similarities with e.g. Trosterud 1 and Vinterbro 3 (see Berg 1997, Jaksland 2001), the site was originally dated to the initial part of the Nøstvet phase, c. 6300 BC. However, Eigeland's (2015) recent technological analysis of the Torpum 1 material identified that a combined production of blades and microblades based on conical/semi-conical cores, and not handle cores, has been at the centre of the flint reduction strategy. Eigeland concludes that the technology identified in the Torpum 1 material is distinctly Middle Mesolithic, not Late Mesolithic. The Torpum 1 finds share far more similarities with e.g. the Middle Mesolithic Langangen V. 1 than with the Late Mesolithic Vallermyrene 4 from the classic Nøstvet phase. Compared to settlement site material from the latest third of the Nøstvet phase, the Torpum 1 finds may contribute to a clearer picture of Glørstad's (2004) revision of the Nøstvet phase. On the other hand, the Torpum 1 finds cannot be used to demonstrate any technological break around 6300–6000 BC.

In my opinion, there is nothing in the archaeological record, either in the Vestfoldbane project material or in previously excavated settlement site material, to justify maintaining a phase transition around 6350 BC. Instead, the assemblages collected from sites like Langangen V. 1, Gunnarsrød 6, Gunnarsrød 4, Trosterud 1, Torpum 1 and the Brunstad sites reflect continuity in terms of both artefacts typical of their period and technology between c. 7000 BC and c. 5600 BC. A marked break appears around 5600 BC. At this point, the strong chubby adze tradition is replaced by an even stronger Nøstvet adze tradition. At the same time, the production of microblades from handle cores becomes central in the technological strategy, whereas the production of wider blades ceases. Thick flake borers are another typical artefact that is introduced at this point. These changes are potentially some of the most manifest and abrupt ones of the entire Mesolithic. Vallermyrene 4 in Porsgrunn, Telemark, dated to c. 5500–4800 BC (Eigeland and Fossum 2014), illustrates these shifts in adze- and flint production strategies especially well (cf. Nordqvist 1999, 2000a on synchronous, similar changes in bordering areas of western Sweden).

The chronological delimitation of the Late Mesolithic Kjeøy phase

There are similarities in the core material as well as in the blade/microblade material from the late Nøstvet phase and the early Kjeøy phase, according to Glørstad (1998a, 2004). Even so, Eigeland (2015, p. 379) has identified clear-cut qualitative technological differences between them. These changes encompass a distinct decrease in bipolar cores, increased blade production and new strategies within stone adze production. Based on these changes, Eigeland suggests that the material recorded from the last centuries of the Mesolithic may be traces of a new population possibly migrating from southern Sweden. A discussion of a possible migration is beyond the scope of the present paper. However, it is worth pointing out that the sites analysed in connection with my study also reflect considerable changes at the end of the Mesolithic, with Vallermyrene 4, Krøgenes D2 and Vallermyrene 1A on one side of the break, and Langangen V. 3 and Vallermyrene 1B (in addition to the northern part of Langangen V. 5) on the other (see Figs. 13 and 15).

As noted at the beginning of this paper, I would claim that the chronological delimitation of the Kjeøy phase is not satisfactory. Glørstad's (1998a) dating of the transition between the Nøstvet phase and the Kjeøy phase relies heavily on the shoreline dating of the site Halden 5, the youngest of five Mesolithic sites investigated in 1989 in Halden municipality, Østfold County (Lindblom 1990). Finds from the excavation included 34 transverse-tipped arrowheads (but no other arrowhead types), in addition to eight stone adzes – all classified as atypical (Juhl 1990). The majority of the finds are assumed to date to the Kjeøy phase. However, the radiocarbon dating results span from c. 5150 BC to c. 4350 BC, indicative of multiple occupations over several centuries (see Reitan 2016, Note 6 for 2 σ recalibrated dating results from Halden 5). The arrowheads were mostly recovered from the lower end of the site, around 40 m.a.s.l., where the hearths providing the youngest radiocarbon dates were located. Local topographical features and the relative sea level changes in the area (cf. Sørensen 1999) indicate that the lower part of Halden 5 was occupied from 4500 BC at the earliest. These factors reveal that Halden 5 cannot firmly contribute to establishing the beginning of the Kjeøy phase at 4650 BC. This is in line with the conclusion drawn by Dekov Hafting (2007) in her re-analysis of the Halden 5 material (cf. Jaksland 2003, Glørstad 2004, p. 28 on the Svinesund site Rørbekk 1). In my opinion, there is no evidence for dating the Nøstvet phase/Kjeøy phase transition any earlier than c. 4500 BC.

Along with the introduction of flint projectile points, the Vestfoldbane project sites demonstrate another marked change in the adze material at this transition: the adzes are fewer, are produced in a different manner, and they exhibit traces of more extensive grinding in comparison with adzes from the preceding Nøstvet phase (see Fig. 16A).

The end of the Late Mesolithic and the beginning of the Early Neolithic is commonly dated to 3800 BC (Fig. 2). Instead, I would suggest a backdating of the transition to the Neolithic to 3900 BC, and that this should not be based on a poorly mapped shift to a farming mode of production, but rather on the introduction of ceramic vessels and polished axes of stone and flint with a four-sided cross-section. Such finds were unearthed at Langangen V. 5 and Langangen V. 6 (Reitan 2014c, 2014d). The presence of pottery and polished flints in contexts predating 3800 BC, traditionally acknowledged as Late Mesolithic time, has previously caused an interpretational problem (Glørstad 2004, p. 34–35). The two Langangen sites at the Langangen Fjord in Telemark, mentioned above, can be characterized as typical,

marine oriented foraging sites. The recorded assemblages from the two are clearly comparable with, for example, two sites excavated within the Svinesund project in Østfold – Vestgård 3 (Johansen 2004) and Vestgård 6 (Jaksland and Tørhaug 2004, cf. Glørstad 2004). In addition, all these sites have provided radiocarbon dates where the calibrated results point to an earlier date than 3800 BC. Several other sites in southeastern Norway with typical Early Neolithic elements have provided equivalently early dating results (e.g. Sjurseike 1991, Glørstad 1998b, Solheim 2012, p. 127–129, Bjørkli and Mjærum 2016).

Concluding remarks – a revised chronology of the Mesolithic in Southeast Norway

The analysis outlined in the present paper is based on trends and breaks identified in the archaeological record from a large number of recently excavated sites and associated radiocarbon dating results. My assessment does not support the established chronological division of the Mesolithic in southeast Norway. Especially, there is reason to question the asserted duration of the Nøstvet phase between c. 6350 and 4650 BC. I have demonstrated that there are much closer similarities between sites dated to 6800 BC and 5800 BC (e.g. Langangen V. 1 and Brunstad) than there are between sites dated to 5800 BC and 5300 BC (e.g. Brunstad and Vallermyrene 4). In my view, the designation 'the Nøstvet phase' should be reserved for the time frame when the Nøstvet adze was in use (Fig. 18), i.e. the just over one-thousand-year-long period often referred to as the 'classic Nøstvet'.

If the division of the Early Mesolithic into two sub-phases is valid, the Mesolithic period can be divided into six instead of four different sub-phases. To avoid confusion with previously applied terms on various phases in southeast Norway, I suggest a division of the Mesolithic as shown in Figure 17. The outlined chronological development has several similarities with trends identified in the archaeological record from bordering areas of western Sweden. Moreover, the backdating of the Mesolithic/Neolithic transition to 3900 BC is in line with the dating of the transition in both southern Sweden and Denmark.

Phase name	Cal. BC	^{14}C -years BP	Major chronological markers
Early Mesolithic 1 'The single-edged point phase'	9300–8600 BC	9800–9350 BP	Single-edged points, tanged points, Høgnipen points, blades, narrow blades, flake axes, one-sided single-platform cores, microburins, blade small-tools
Early Mesolithic 2 'The Høgnipen point phase'	8600–8300 BC	9300–9100 BP	Høgnipen points, lanceolate microliths, core axes, flake chisels, microburins, blade tools, blades, narrow blades, one-sided single-platform cores
Middle Mesolithic 1 'The microlith phase'	8300–7000 BC	9100–8000 BP	Various microliths (mainly scalene triangles), core axes, hatchets/mace heads with shaft-hole, chubby adzes, blade tools, rulers, conical cores, bipolar cores
Middle Mesolithic 2 'The chubby adze phase'	7000–5600 BC	8000–6700 BP	Pecked chubby stone adzes, flat stone chisels, sandstone knives, sandstone grinding slabs, blade small tools, blades, microblades, conical/semi-conical cores, bipolar cores
Late Mesolithic 1 'The Nøstvet adze phase'	5600–4500 BC	6700–5650 BP	Nøstvet stone adzes, sandstone grinding slabs, sandstone knives, flint flake borers with triangular cross-section, microblades, handle cores
Late Mesolithic 2 'The transverse arrowhead phase'	4500–3900 BC	5650–5100 BP	Transverse points, tanged points, single-edged points, blade small tools, blades, microblades, blade-like flakes, various platform cores

***Figure 17**: Suggested new chronological outline for the Mesolithic of Southeast Norway.*

Differences in time and space, such as shifts in raw material procurement strategies, new tool types and new tool production techniques, may reflect actual cultural historical breaks. Minor adjustments of a century or two back or forth can seem insignificant in terms of the time frames that we are dealing with in Stone Age research. In transitional phases, however, such adjustments might contribute to an increased knowledge of key social processes like the transmission of knowledge and techniques, or even migrations. The settling of new groups into the region may be the backdrop of several of the discussed transitions, e.g. the one around 5600 BC (see also e.g. M. Sørensen et al. 2013, Eigeland 2015, p. 379, Damlien 2016a, 2016b, Damlien and Solheim 2018, Kashuba *et al.* 2019).

It is anticipated that coming investigations will shed more light on Mesolithic chronology in southeast Norway, and hence test the validity of the outline suggested in this paper.

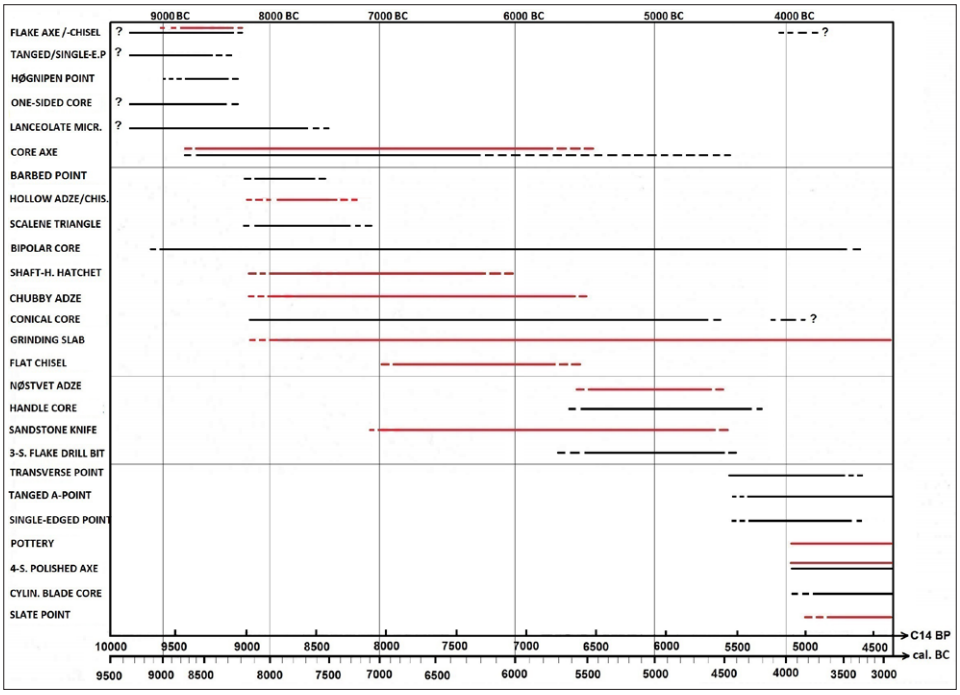

***Figure 18**: Timeline showing the period of use of selected diagnostic Mesolithic and Early Neolithic artefacts. The graph is based on a large number of both published and previously unpublished excavation results. Black lines are flint, red lines are other lithic raw materials or ceramic ware. The uneven spacing of the 500-year periods on the axis of calibrated age owes to different plateaus in the calibration curve. Illustration: G. Reitan/Museum of Cultural History.*

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In this volume, 10 papers from the Stone Age Conference in Bergen 2017 are presented. They range thematically from the earliest pioneer phase in the Mesolithic to the Neolithic and Bronze Age in the high mountains. The papers discuss new research and methodological developments showing a diverse and dynamic Stone Age research community in Norway.

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