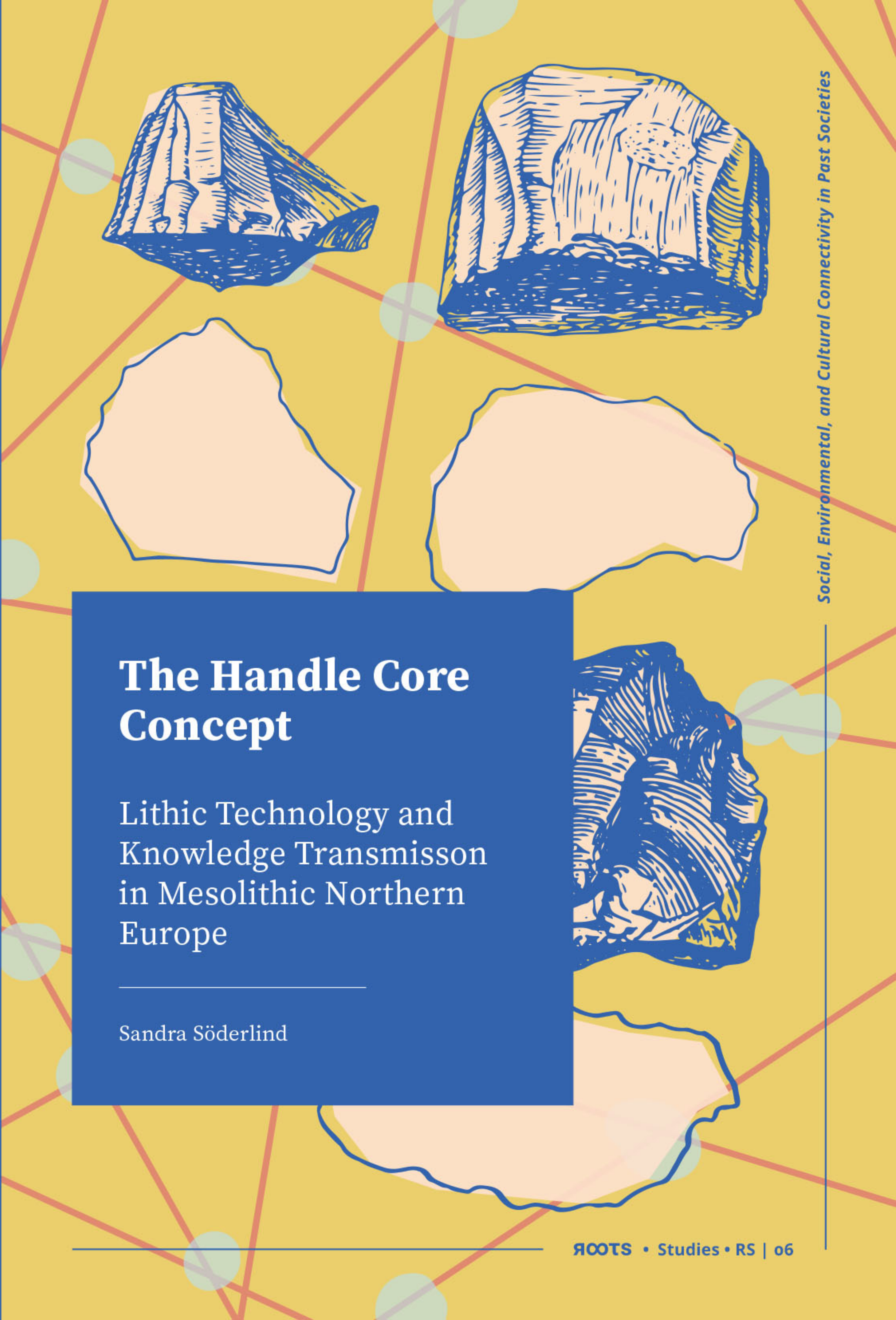

Social, Environmental, and Cultural Connectivity in Past Societies

The Handle Core Concept

Lithic Technology and Knowledge Transmisson in Mesolithic Northern Europe

Sandra Söderlind

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ROOTS cluster of excellence

CAU Kiel University Christian-Albrechts-Universität zu Kiel

JMA

Foreword of the series editors

As the outcome of overarching, interdisciplinary scientific research efforts within the Excellence Cluster 'ROOTS – Social, Environmental and Cultural Connectivity in Past Societies' at Kiel University, we are pleased to present the sixth volume of the publication series **ROOTS Studies.** This book series of the Cluster of Excellence ROOTS addresses social, environmental and cultural phenomena as well as processes of past human development in light of the key concept of 'connectivity' and presents scientific research proceeding from the implementation of individual and cross-disciplinary projects. The results of specific research topics and themes across various formats, including monographs, edited volumes/proceedings and data collections, are the backbone of this book series. The published volumes serve as a mirror of the coordinated concern of ROOTS researchers and their partners, who explore the human-environmental relationship over a plurality of spatial and temporal scales within divergent scientific disciplines. The associated research challenges revolve around the premise that humans and environments have interwoven roots, which reciprocally influence each other, stemming from and yielding connectivities that can be identified and juxtaposed against current social issues and crises. The highly dynamic research agenda of the ROOTS Cluster, its diverse subclusters and state of the art research set the stage for particularly fascinating results.

The new book in the **ROOTS Studies** series presented here is a result of an intensive analysis of technological developments in material culture. In an excellent investigation on the handle core concept, the author succeeds in presenting similarities and differences in developments and distribution areas both diachronically and spatially. Once again, it becomes clear how important it is to make use of multivariate methods based on reliable data.

The editors of the **ROOTS Studies** series would like to take the opportunity to thank those colleagues involved in the successful realisation of the sixth volume. We are very grateful for the detailed and well-directed work of the ROOTS publication team. Specifically, we thank Andrea Ricci for his steady support and coordination efforts during the publication process, Petra Horstmann for image editing and the preparation of the cover design and Eileen Küçükkaraca for scientific editing. Moreover, we are continually indebted to the peer reviewers and our partners at Sidestone Press, Karsten Wentink, Corné van Woerdekom and Eric van den Bandt, for their support and their commitment to this publication.

Kiel, May 2024
Eileen Eckmeier, Martin Furholt, Lutz Käppel, Johannes Müller

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Preface of the author

This work is the result of the research related to my PhD project that took place between 2018 and 2022. The project was carried out, initially, as a part of the *Graduate School Human Development in Landscapes*, which later became the *ROOTS Young Academy*, at Kiel University.

Ever since my first practical archaeology course, I have identified myself as a flint nerd. The fact that all those tiny marks and bumps on flint can tell something about the people who knapped it so long ago has always seemed somewhat nuts to me. Thus, it was so intriguing to learn more about this phenomenon. Somehow, it is a way of speaking to (or rather, receiving a whisper from) people from several thousand years ago.

My interest in the Mesolithic comes from a wish to investigate a time period that we still know quite little about in order to produce some new piece of knowledge that was not there before. Therefore, one of the big motivations for me during the project was to imagine that other researchers would benefit from the research that I was doing, some day. So, here it is. I hope someone out there will find it useful.

Sandra Söderlind
Autumn 2023

Acknowledgements

This work would not have been possible without the support and help of so many colleagues and friends. First of all, huge thanks are extended to my supervisors Prof. Henny Piezonka and Prof. Berit Eriksen for their endless support, insightful comments and advice throughout the entire project.

I am exceptionally grateful to everyone who helped me with the material studies across Europe. *Vielen Dank* to Dr. Sönke Hartz from the Landesmuseen Schleswig-Holstein for all his help and guidance during the studies from Northern Germany. Thanks also for all the discussions and for sharing extensive knowledge and enthusiasm for the archaeological assemblages. My thanks are also due to Mirjam Briel, M.A., for good discussions and friendly support. Furthermore, I want say *jättetack* to the researchers in Lund, especially Mathilda Kjällquist, fil. lic. and Joen Leffler, M.A. at Arkeologerna in Lund as well as Arne Sjöström and Dr. Björn Nilsson at Lund University. Your expertise concerning the archaeological materials made my work much easier. *Tak* also to Prof. Mikkel Sørensen at Copenhagen University who helped me understand both the archaeological and experimental aspects of the handle core concept from Denmark. *Mange takk* to Prof. Hege Damlien, Dr. Inger Marie Berg-Hansen, Guro Fossum, M.A. and Gaute Reitan, M.A. at the University of Oslo for making my studies there very productive and enjoyable. Furthermore, I want to say *spasibo* to Prof. Mikhail Zhilin at the Russian Academy of Sciences, in Moscow, who made it possible for me to study several assemblages from the Upper Volga region. My thanks also go to Anna N. Pichugina at the museum in Tver for her hospitality during my material

studies there. Many Dziękuję must also go to the knowledgeable researchers who helped me during my studies in Poland, including Dr. Michał Przeździecki, Dr. Katarzyna Pyżewicz and Mgr. Witold Grużdź from the University of Warsaw, for all their friendly helpfulness, as well as for taking me all across Northern Poland in search of handle cores (and tasty food). Additional thanks are extended to the researchers at the museum in Bialystok for good discussions and for sharing their Mesolithic assemblages. For all their help regarding the material studies at the Institute of Archaeology and Ethnology – Polish Academy of Sciences, in Poznan, I say *Dziękuję* to Prof. Iwona Sobkowiak-Tabaka, Prof. Jacek Kabaciński and Mgr. Jakub Mugaj. A large *Ačiū* must go to Dr. Tomas Rimkus at Klaipeda University who helped me go through numerous assemblages from Southern Lithuania and whose hospitality made my visit to Lithuania wonderfully productive. Thanks also to Julia Berg for help with the graphs.

Special thanks also go to all my colleagues and friends who offered help and support in other regards, including Kjel and Helena Knutsson, Michel Guinard, Therese Ekholm, Jackie Taffinder, Nathalie Hinders, Gregory H. Tanner, Fredrik Hallgren, Adam Boethius, Jan Apel, Ola Magnell and Harm Paulsen. Thank you also to all my smart and funny colleagues in the GSHDL/ROOTS office for making my stay in Kiel very enjoyable. A special thanks are also extended to the Museum Lolland-Falster and all the colleagues there for cheering me on in the final phase of the project. Thanks also to all my fellow archaeologists who I forget to mention now, but who were nonetheless extremely helpful. I simply have too many people who supported me throughout the whole project. Just… thank you!

Thanks also to my incredibly supportive family and friends, for always listening and being able to tell me when to slow down and when to push forward. Finally, a HUGE thanks to Daniel Groß for help with the translations, proofreading and layout, not to mention all the emotional support throughout these years.

This project was made possible by financial support from the ‘Graduate School Human Development in Landscapes’ and the ‘Excellence Cluster ROOTS at Kiel University’. Additional funding was also received from ‘Svenska Fornminnesföreningen’.

Sandra Söderlind

1 Introduction

The introductory part of this thesis will highlight the relevance of the work within past and current research (1.1), provide a scope for the geographical and temporal limitation of the study as well as a brief introduction to the materials (1.2) and present the objectives and research questions pertaining to the investigations (1.3).

1.1 The relevance of a study of past mobility, contacts and transmission of knowledge

In the world today, we see increased mobility of people on several spatial and social scales. Long-distance travelling, work abroad and remote-living have been made available to many people with the help of modern technologies. Additionally, an increase in global populations, conflicts, warfare, famine, disease and many forms of social injustices tend to accelerate mobility on multiple spatial scales. This, in turn, leads to political discussions relating to topics of migrations, identity, traditions, contact and communication, *etc.* Although the political discussions often apply a rather limited temporal focus, the topics have been relevant for most of human history. By studying mobility, contacts and transmission of knowledge in the Mesolithic, we can approach these matters from a longer-term perspective. This could also allow us to address the social implications of these themes. Through this, we can not only learn about past mobility, contacts and transmission of knowledge but also understand our current experiences in a better way by creating a historical context for these, still highly relevant, topics. Furthermore, past trends can be helpful in order to prepare for the future (*e.g.* Rick and Sandweiss 2020; Coningham and Lucero 2021).

The Mesolithic in Northern Europe saw plenty of migrations and diffusion processes on various spatial scales (Inizan 2012; Sørensen *et al.* 2013; Damlien 2016b; Günther *et al.* 2018; Kjällquist and Price 2019). The reasons for these migrations are likely related to a multitude of different social, economic, environmental and (to us) invisible factors. Exactly how these factors play into aspects of migration and a diffusion of ideas is complex and not yet well understood. It is for this reason that I will focus on the Mesolithic period to explore the topics of past mobility, social interaction and transmission of knowledge.

Mesolithic societies are mainly conceptualised on the basis of material culture that they left behind, largely in the form of lithics. Since these lithic remains were produced and used within a social setting, in the interaction within and between mobile hunter-gatherer societies, we can study these remains in an effort to also approach the more hard-to-reach social spheres (Dobres 2000; Jordan 2015). The lithic remains are often related to different technologies, techniques, methods and practical knowledge needed for the production of an artefact. Since these technologies are learnt, implemented and transferred in social settings, between individuals, they can be viewed as social structures or phenomena (Lemonnier 1976; Leroi-Gourhan 1993 [1964]; Dobres 2000). A useful way to study technologies is through studies of the full operational chain (*chaîne opératoire*), which involves all steps of the production, use and discarding of an artefact. Each phase in the *chaîne opératoire* results in material remains indicative of the individual and (often) social activities involved in the process (Lemonnier 1976; Leroi-Gourhan 1993 [1964]; Dobres 2000; Eriksen 2000; Jordan 2015). Through studies of individual technologies, it therefore becomes possible to approach the social situations in which the technology was used and transmitted between individuals.

Technologies are often interlinked with other technologies, all of which are necessary for the production and use of various artefacts. Based on anthropological studies, it is also clear that each technology comes with its own set of social, material, bodily and cognitive processes. No technology is the same, and therefore does not “behave” in the same way, as seen in the material culture or otherwise (Hodder 1982; Jordan 2015). Therefore, it is important to study technologies individually, on a case-by-case basis, to understand their dynamics and traditions, as well as the mechanics involved in their specific patterns of transmission of knowledge and know-how (Jordan 2015, 362).

The investigation of technology in relation to transmission of knowledge and migrations during the Mesolithic will provide a better basis for an understanding of prehistoric social processes and the material culture created within them. Furthermore, an understanding of past patterns of mobility and knowledge transfer may also benefit our understanding of current discussions regarding migration, environment and social interaction.

1.2 Research area, materials and temporal scope

This study focuses on furthering the understanding of mobility, contacts and transmission of knowledge during the Mesolithic in Northern Europe. The research area (Fig. 1) consists of most of Northern Europe, stretching from

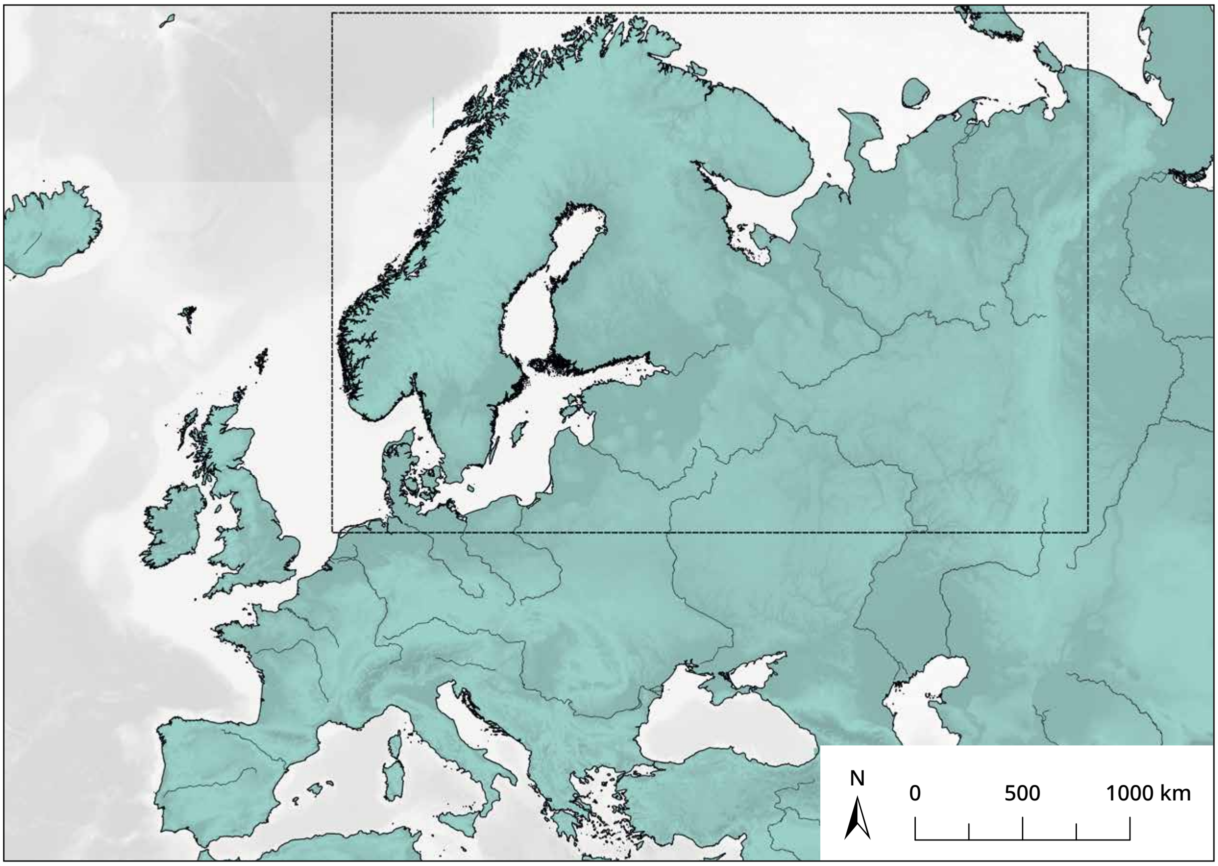


Figure 1. Extent of the research area (within dashed line) in Northern Europe with a topographic map and large rivers (Source: The image contains modified SRTM data (2014)/NASA, processed by mundialis (www.mundialis.de)).

Norway in the west to the Urals in the east. The northern perimeter is the Barents Sea and the southern border goes through the northern parts of Germany, Poland and Southern Lithuania.

The project follows one technology, centered around a blade production concept from a single-fronted core that is known in Scandinavia and Northern Germany as a *handle core*. The handle core concept is characterised by the production of small and regular blades that were used in composite tools, such as slotted bone points. The blades are commonly described as having been produced from single-fronted and elongated cores by means of pressure technique (Larsson 1978; Knutsson 1980; Olofsson 1995; Sørensen 2001; 2006; Frandsen 2015). The handle core concept has been described as technologically complex, mainly due to its implementation of pressure technique (Pelegrin 2012). Although the term complexity has been used in various ways (cf. Hoffecker and Hoffecker 2018), the term here mainly refers to the multiple types of knowledge (and know-how) relating to the several procedural units involved in the *chaîne opératoire* (similar to the definition by Perreault *et al.* 2013).

Due to this complexity, the implementation of the handle core concept requires both theoretical knowledge (*explicit knowledge*) and practical know-how (*tacit knowledge*). Therefore, we can assume that the transmission of knowledge took place within a social arena (Schiffer 1972; Lemonnier 1976; 1980; Pelegrin *et al.* 1988; Pelegrin 1990; Leroi-Gourhan 1993 [1964]; Rogers 2003). Thus, this concept connects the material culture, via technology, to the social setting in which it was created. Therefore, it becomes a useful proxy to approach learning, teaching and the social setting in which the transmission of knowledge occurred.

The term *transmission of knowledge* is often used as meaning both the transmission of knowledge and know-how, which is also how I use it in this work. Furthermore, I use the term *knowledge diffusion* or *diffusion of knowledge* in the same way as *transmission of knowledge*. The term *diffusion* has commonly been used to express the spread of an idea or concept, as opposed to the spread of people/migration (cf. Hakenbeck 2008). However, I use the term diffusion here without assuming anything about the character of the process, since I assume that the spread of any idea (such as a technological concept) must have involved both migration and the diffusion of thoughts simultaneously.

The similar terms *handle core* and *single-fronted core* are also used throughout the thesis and could be interpreted as being synonymous, but here they are not used as such. I use the two terms to refer to the Scandinavian/Northern German cores (as handle cores) and the unexplored cores in other parts of Northern Europe (as single-fronted cores). I do this since I, as a starting point, do not know if these cores in various parts of Northern Europe relate to each other. The handle cores have a long research history with a multitude of investigations that describe the concept (cf. Chapter 2), in which the cores were implemented, in detail. The concept that relates to the similar (wedge-shaped) cores from other parts of Northern Europe are still largely unknown. Therefore, I refer to them by their general morphology and I do not relate them to the (already established) handle core concept before their technology has been investigated and the relation between the materials have been explored. This usage of terms will be further discussed in Chapter 7, when the data has been analysed and discussed.

The handle core concept is assumed to have been used during a large part of the Mesolithic, although the details of the chronology have been heavily discussed due to source critical issues and lacking absolute dates (Cullberg 1972; 1974; Welinder 1974; Olofsson 2002). The ambiguous state of the chronology also means that no temporal limitations are pre-set for this study. Instead, an effort will be made to investigate the time span in which the concept is implemented. Nonetheless, the handle cores have been used as a typological marker for the Late Mesolithic within Scandinavia, despite its poor chronological state (cf. Becker 1953; Althin 1954; Mikkelsen 1975). The concept is also known in Northern Germany where cores are commonly found on Mesolithic sites that relate to the Late Maglemose or Kongemose technocomplex (Hartz 2009). It is also in these areas (Scandinavia and Northern Germany) where the concept has been previously investigated (Fig. 2). Studies have mainly focused on regional and intraregional technological and chronological analyses (Mikkelsen 1975; Larsson 1978; Olofsson 1995; Sørensen 2001; 2006; Hartz 2009; Eigeland 2015; Frandsen 2015; Söderlind 2018). Previous studies have also proposed that the concept was also implemented in other parts of Northern Europe (*e.g.* Galiński 1992; Olofsson 2002; Hartz *et al.* 2010; Rimkus 2018). However, the distribution of the handle core concept, its technological characteristics and its relation to other similar technological concepts beyond Scandinavia/Northern Germany are explored for the first time in this project.

A similar concept, focused on blade production from single-fronted cores (and other types of cores) using pressure technique, was already established in the Late Palaeolithic in Northeastern Eurasia. It has been suggested that this Palaeolithic concept may have gradually spread in multiple directions, one of them being westwards into Europe (cf. Smith 1974; Inizan 2012). However, few studies have investigated this migration/diffusion process and the materials are characterised by a

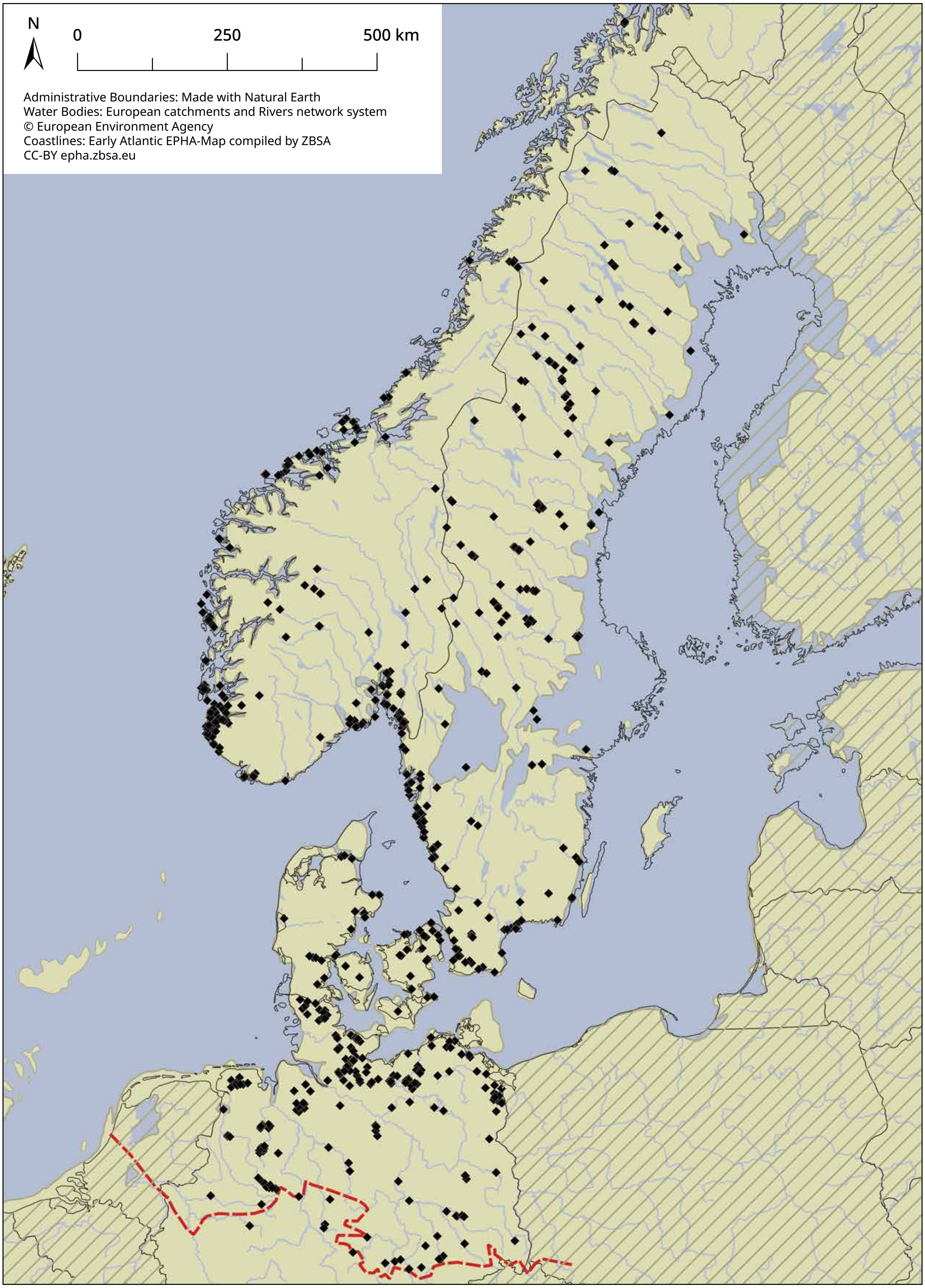


Figure 2. Map of all handle cores registered within national databases in Sweden, Norway and Denmark as well as within archaeological reports from Schleswig-Holstein. A red line marks the southernmost distribution of Scandinavian flint (Source: Söderlind *et al.* 2023).

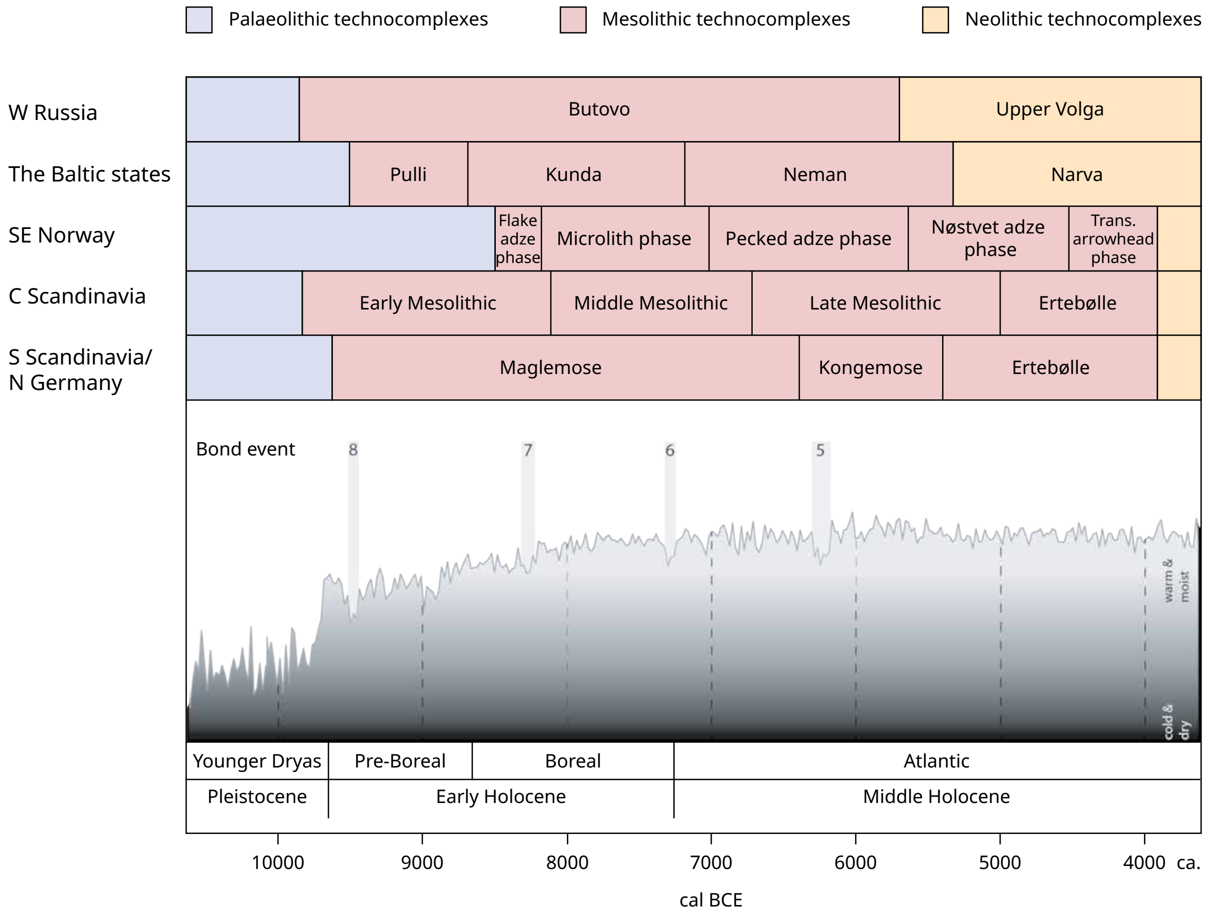


Figure 3. A schematic overview of some of the different chronologies used within the research area (from individual chronologies in: Hartz *et al.* 2010; Reitan 2016; Apel *et al.* 2018; Sørensen *et al.* 2018; Groß and Rimkus in press). Temperature variations are based on Greenland ice cores (from NorthGRIP) from the Early and Middle Holocene.

lack of over-arching technological studies that investigate the relationship between these finds in different parts of Northern Eurasia. Furthermore, a recent review study (Coutouly 2018) found source critical issues related to some of the research and publications that make up the basis for data on microblade cores from Northeastern Asia. Many of the finds are dated using old or unreliable radiocarbon dates or come from problematic stratigraphic sequences. Coutouly (*ibid.*) could also show differences in how the microblade cores were defined and reported across the area, which makes reliable technological comparisons difficult at the current time. More studies are thus needed to comprehend the diffusion of knowledge and know-how both in Northern Europe and in Northeastern Asia.

This study will, however, focus on the concept within Northern Europe. Nonetheless, this geographical scale will allow for a mapping of the technology of the handle core concept on an interregional scale, within different regional chronologies (Fig. 3), investigate the chronology of the concept and, through that, approach topics relating to communication and transmission of knowledge. The wide geographical scope of the study will also allow for a comparison of the technology within different types of (changing) landscapes (*e.g.* islands, shores, forests) and along different natural barriers/connectors in the landscape (*e.g.* shorelines, rivers, mountain ranges). The effects of the dynamic environments during the Mesolithic (*e.g.* Björck 1995; Svenning 2002; Aaris-Sørensen 2009; Zanon *et al.* 2018) and the ecological, economic and social implications of them will also be discussed in relation to the handle core concept.

1.3 Objective and research questions

The objective of the project is to investigate mobility, contacts and transmission of knowledge during the Mesolithic in Northern Europe. This will be done by tracing and mapping the knowledge and know-how relating to a specific lithic technology centred on handle cores. The analyses will highlight similarities and differences in the technology across Northern Europe. An understanding of these patterns will be reached within a chronological setting, which allows us to approach the mechanics behind the migration/transmission/diffusion process.

Three broader themes with more specific research questions will be used to approach these topics:

1. The technology of the handle core concept
- Which technological attributes define the handle core concept?
- Which technological similarities/differences within the concept exist within and between different parts of the research area?

2. The chronology of the handle core concept
- What is the chronology of the handle cores within and beyond Scandinavia?
- Which diffusion routes can be observed in relation to the handle cores within the research area?

3. Transmission of knowledge and know-how in the research area
- What are the characteristics of knowledge transmission related to the handle core concept?
- Which social mechanics are involved in the diffusion of knowledge and know-how in the research area?
- What are the implications for the spread of the handle core concept in different landscapes and during the dynamic environments of the Mesolithic?

The investigations of the handle core concept will be executed by means of technological analyses of cores and blades related to the handle core concept in different areas of Northern Europe. The focus areas (F) that were chosen for closer analysis are: F1) The Upper Volga region (in Western Russia), F2a) Southern Sweden, F2b) Northern Germany, F3) Southeastern Norway and F4) Southern Lithuania. These areas were selected mainly due to the presence of relevant finds and available materials for study. The data is recorded using a dynamic attribute scheme focused on mapping the preparation of the core and the blade production processes. The resulting data will undergo both descriptive statistical analysis and multivariate analysis in order to highlight any technological differences and similarities between and within the different areas. These results will then be discussed and interpreted against a wider theoretical background, including cultural transmission theory, and with perspectives from diffusion and anthropological studies.

2 Previous research and state-of-the-art

The relevant previous research and state-of-the-art relate to three overarching topics: Handle cores (2.1), Mesolithic mobility and contacts (2.2) and Mesolithic landscapes (2.3), all of which will act as a foundation for the new results and discussions.

2.1 Handle cores

Two parallel discussions have dominated the research history of the handle core concept. The first discussion regards the handle core's *definition and use* (2.1.1) and the second relates to its *chronology* (2.1.2). These discussions do not only reflect the changing state of research relating to the handle core concept but they also highlight the changing research paradigms within archaeological research over time.

2.1.1 Definition and use of the handle core

2.1.1.1 Handle cores – A chronological overview of the research history

A common feature within the culture history paradigm was to map and describe cultural features in an effort to better understand and explain them (Johnson 2010, 15-21). This trend is also reflected in the earliest written accounts of the handle core. Already in 1886, the Swedish-Danish nobleman C. D. Reventlow described

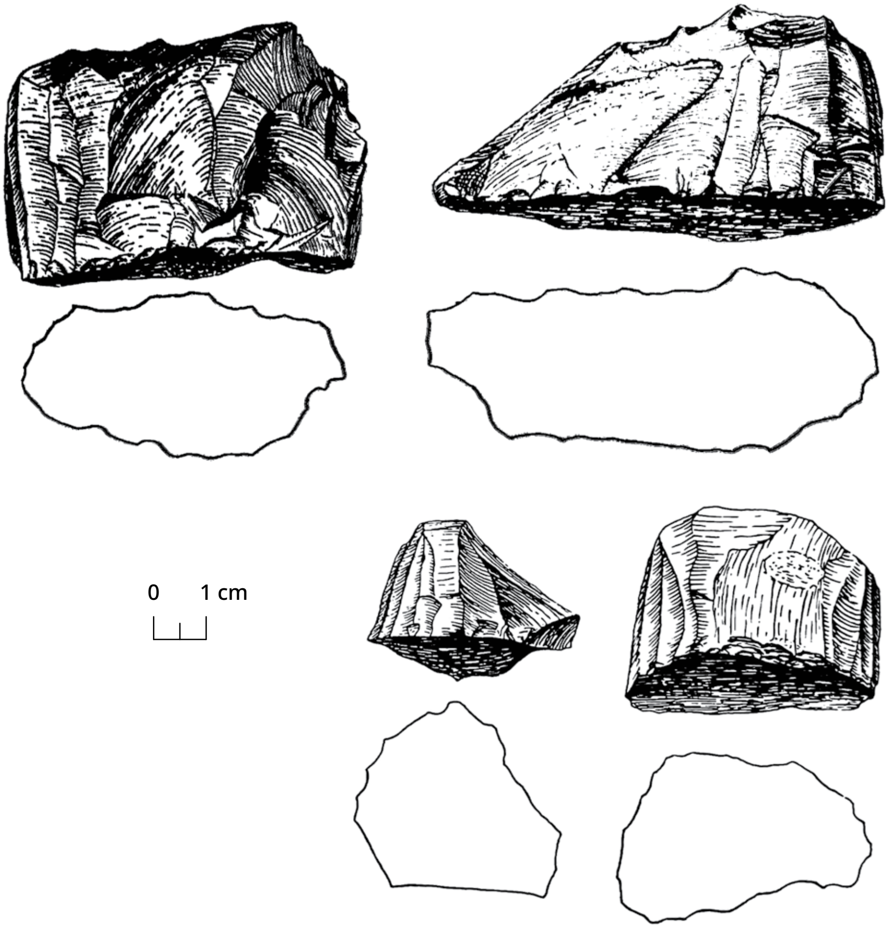


Figure 4. Four handle cores from the site Ageröd V (Scania, Sweden, after Larsson 1983, 30).

finds from the Rönne River outlet (Scania, Sweden) as "flint cores with handles" (swe: "*flintkärnor med handtag*", Reventlov 1886, 143). Similarly, Friis Johansen described the same core type from the site Sværdborg (Funen, Denmark) in 1919 as "cores with handle" (dan: "*bloke med håndtag*"; Friis Johansen (1919, 156), as cited in Frandsen 2015). These accounts were important as the first descriptions of the handle core, and were focused on the core's elongated shape, which was interpreted as a handle (some examples of handle cores can be seen in Fig. 4). The discussion of whether the core shape actually represents a functional handle continues throughout much of its research history but the term was established and has remained in use until today.

Soon after the first descriptions of the handle core, a new interpretation for its function was suggested by Westerby (1927, 56-57). He argued that it was a keel-shaped scraper (*dan*: "*kølformede Høvlskrabere*"), due to the presence of frontal retouch on the core which he interpreted as a scraper edge. Furthermore, he argued that variation in core length represented different core types (*ibid.*). Broholm (1927, 155, as cited in Larsson 1978) went soon on to dispute this, arguing that the retouch on the front of the core was created during the production of blades. This is the start of a long-lasting debate regarding the interpreted use of the handle core, as a core or a scraper.

The debate is continued by Mathiassen (1937, 84, as referenced by Frandsen 2015) who argued that the handle core should be defined as both a core and a scraper. A decade later, however, Mathiassen (1948, 16, 21, as referenced by

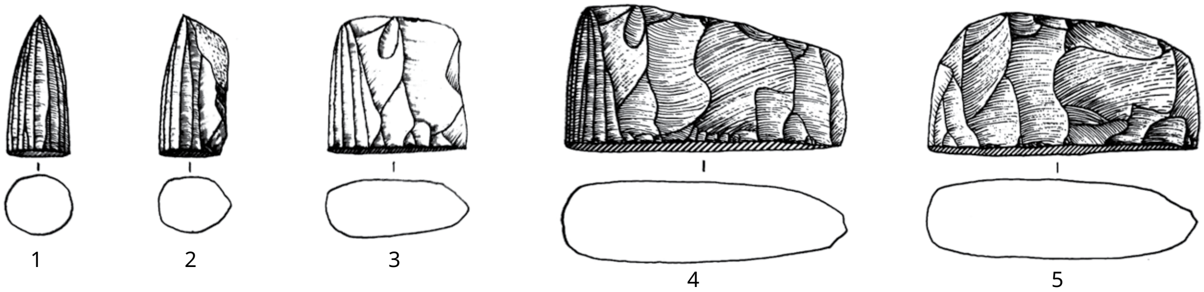


Figure 5. Various types of microblade cores from Sværdborg I. 1) Conical core with blade scars covering the core; 2) Conical core with blade scars covering a part of the core; 3) Keeled core; 4) Handle core with an obvious blade scar front; and 5) Handle core without the blade scar front (from Bille Henriksen 1976, 19).

Frandsen 2015) alters his interpretation and instead describes handle cores and keeled scrapers as two different artefacts. But he maintains that keeled scrapers often are made from handle cores. The handle core *vs.* keel scraper discussion appears not to have been driven by new research results, but rather by differing personal interpretations, based simply on the core morphology.

As the debate regarding the definition and use of the core enters the 1970s, the character of the discussion changes. The definition and use of the handle core switches from a basis relating to morphology towards a basis of measurements. This signals a paradigm shift towards *Processual Archaeology* (also known as *New Archaeology*) in which efforts were made by researchers to make archaeology more 'scientific'. This led, for instance, to a focus on quantifying artefacts and attributes (Johnson 2010, 21-27). A good example of this change is seen in the work by Mikkelsen (1975, 31), who argued that handle cores must first follow the established definition of a microblade core, which is defined as a core with at least one microblade negative that measures at least one cm long. In addition to that, handle cores should have its longest measurement along the platform and it needs to show remains of microblade production from one short end.

Another definition was suggested by Bille Henriksen (1976), which was based on the ratio between core front height and platform length. She argued that a handle core height is shorter than the length of the platform. Furthermore, handle cores were also defined by the presence of a distal keel and at least one flaking front. Interestingly, Bille Henriksen did argue that handle cores without blade negatives were, nonetheless, a type of handle core. A handle core without blade negatives but with a retouched edge was instead defined as a "core-scraper". She also defines what is called a "keeled core", which is a find type that has a defined keel but with a core height which exceeds the platform length (*ibid.*, 16-17; Fig. 5).

Further definitions for handle cores and keel scrapers, suggested by Lannerbro (1976, 52-56), were also based on metric ratios. Lannerbro argued that height, width and length played a role in both the use and definitions of the finds. The placement of the blade production front and the regularity of the blade negatives were also important for classification (*ibid.*). Clearly, the measurements were considered highly useful for a definition of the artefacts, not only for its simplicity and comparability but also for its experienced 'scientific objectivity'.

Within the framework of processual archaeology, a focus was also placed on understanding processes rather than on the more static cultural histories suggested by the previous era of archaeologists in the late 1800s and early 1900s (Johnson 2010, 15-21). By investigating the reasons behind different processes, and understanding them during a longer temporal scale, the "cultural processes" could instead be approached (Johnson 2010, 74-75). Within handle core research, this change led to a new way of describing and characterising the cores. Rather than dealing with the artefact as a typological entity with a certain height and width, the handle core is placed within an operational process, including production, implementation and discarding. One of the first to discuss handle cores in a technological sense is Larsson (1978) who, instead of describing the core morphologically or metrically, investigated the dynamic nature of the core. He described the changing core shape during blade production, from being initially elongated and later becoming short. He further discussed the raw material selection process, the shaping of the core and the method for blade detachment. Larsson (*ibid.*) thus showed that the dynamic nature of the core meant that it could not only be defined based on metric (static) rules. He also argued that keel-scrapers were cores, but still in the initial stage of production prior to blade production (Larsson 1978, 55; 1983, 33).

The next person to join the discussion on handle core technology, and chronology, is Vang Petersen (1984; 2014), who argued for the use of various "production methods" in the making of handle cores. The different production methods resulted in different techno-types which, as Vang Petersen argued, were used at different times during the Kongemose period (*ibid.*). In his article from 1984, Vang Petersen describes the "positive" core platform as displaying the remains of a percussion bulb which was produced as a part of the nodule was removed and the platform created. A positive platform is thus made up of one convex surface. A "negative" platform instead is described as a platform that was created by "removing a flake from the core" (*ibid.*, 10), which would result in a concave surface. However, if one nodule is split in two, the two halves would naturally be represented by one positive and one negative platform (as observed by Larsson 1983; Sjöström 2004, 32-33, fig. 34). However, it is interesting to note that the illustrations used by Vang Petersen to explain these platform types show a slightly different image than the written description. The figure showing the negative platform displays multiple flake negatives on one platform (*ibid.*, fig. 8; and here in Fig. 6). If Vang Petersen means that negative platforms can be made up of several flake negatives, then he is actually describing what is more commonly referred to as a faceted platform. If so, his chronological implications might instead relate to the level of platform preparation, rather than just which part of the nodule that became a handle core. Therefore, depending on the scale of the preparation negatives, he might instead argue that handle cores with faceted platforms are older than ones with smooth platforms in Eastern Denmark.

In an effort to further investigate the technological nature of the handle core concept, Knutsson (1980) explores the concept in-depth, with a special focus on which methods were used for blade production from handle cores. He also set out to understand its technological relation to previous technologies implemented in Sweden. He also mapped the character of the technological change as continuous or done step-by-step. In this technological analysis, he concludes that the handle cores have the technological advantage that they can produce a larger number of blades with the same length and width than other blade cores, because of the constant blade production radius. He further suggests that conical microblade cores might be the finished/exhausted form of the handle core (*ibid.*).

The technology of the handle cores is further explored by Andersen (1984), who investigates the concept using the materials from the two Danish sites Mosegården III and Orelund IX (both on Zealand, Denmark). Andersen argues that handle cores and keel scrapers must represent two different artefacts since, as he suggests, if keel scrapers are not scrapers, the "Handle core group" would lack

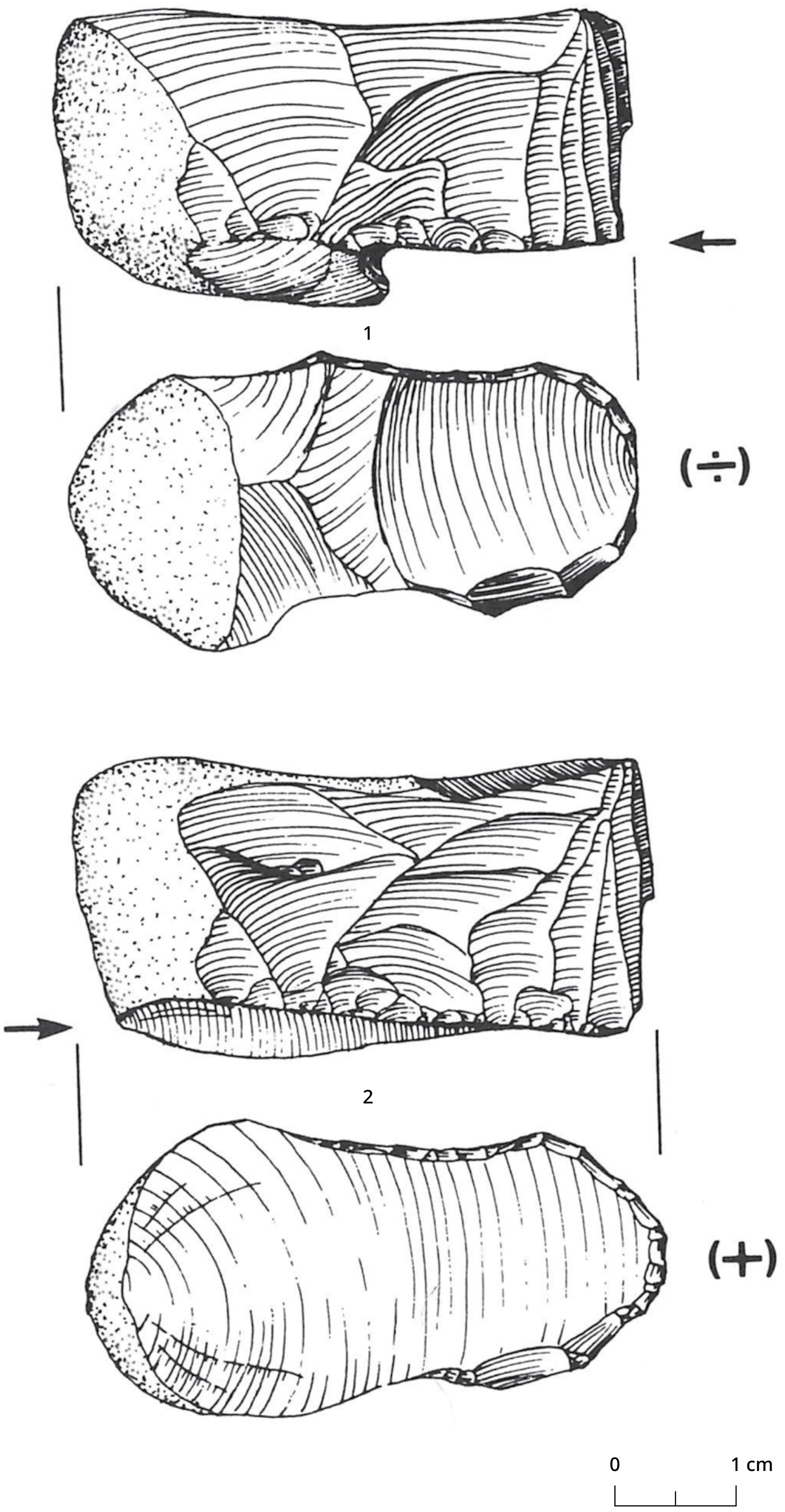


Figure 6. Illustrations of handle cores with positive (+) and negative (÷) platforms (after Vang Petersen 1984, 12).

any scraper tool completely. He goes on to say that this would be very unlikely for a hunter-fisher economy. Furthermore, Andersen also suggests that the “Handle core group” is a direct development from the “Maglemose group” and that the “younger Kongemose group” is a development of the “Handle core group” (*ibid.*). His use of the term “group” here seems to refer to what was previously termed as archaeological “cultures” and used as a simplified way of grouping past communities that (more or less) share the same cultural traditions.

Typical of the processual era was the introduction of hands-on approaches, such as experimental studies for investigations of lithic technology, which have remained in use until today. Experiments have also played an important role for the understanding of the handle core concept. One of the earliest experimental studies was performed by Callahan (1985), who used experimental approaches to understand the holding of the handle core during blade production. His experiments showed that it is possible to produce blades by means of pressure technique from a hand-held core. However, his results also highlighted that more of the core can be used if a clamp was used to hold the core (*ibid.*).

Olofsson (1995) explored the technological character of handle cores in Northern Sweden, and their relation to keel scrapers. In his MA thesis, he argues for a separation between handle cores and keel scrapers. However, he also highlights the problematic nature of the discussion, and concludes that handle cores and keel scrapers are very similar to each other and that many classified keel scrapers may in fact be handle core preforms. Olofsson nonetheless argues that a difference between them is that handle cores have at least two blade negatives at the core front, while the keel scrapers are rounded but without blade negatives (1995, 15-17). Olofsson also investigated the character of the handle core concept in Northern Sweden compared to Southern Scandinavia (Olofsson 1995; 2003). He concludes that although the cores are generally similar in both areas, there are some differences. These include the use of raw materials (flint in the south and various raw materials in the north), size of the core (larger cores in the south) and platform angles (angles of more than 90 degrees are more common in the south). Furthermore, he highlights that microliths are commonly related to the handle core concept in Southern Scandinavia, while almost absent in Northern Scandinavia (Olofsson 2003).

Olofsson expands on the topic of handle cores in his dissertation from (2003), where he explores the chronological and contextual issues related to handle core finds. He suggests that the oldest dates indicate a start of the concept in Southern Scandinavia or on the Swedish west coast. The concept then spread northwards through Central Scandinavia in the early Atlantic chronozone (*ibid.*). However, he also highlights that the current chronologies are complicated due to the lack of finds from clearly distinguished dated/datable contexts (Olofsson 2003). The shift of focus towards the contexts of finds, rather than on just the finds themselves, is a common point of discussion within post-processual archaeology (Johnson 2010, 110).

Experimental archaeology has played an important role in the works of M. Sørensen (2001; 2006), who investigated the various modes of blade production during the Maglemose and early Kongemose periods in Denmark. In these works, he deals with blade production from both conical cores and handle cores. He argues for a switch from conical cores to handle cores based on both “rational” and nature-economic reasons. He goes on to say that the elongated shape of the handle core allowed it to be placed in a (clamp) holding device while blades were

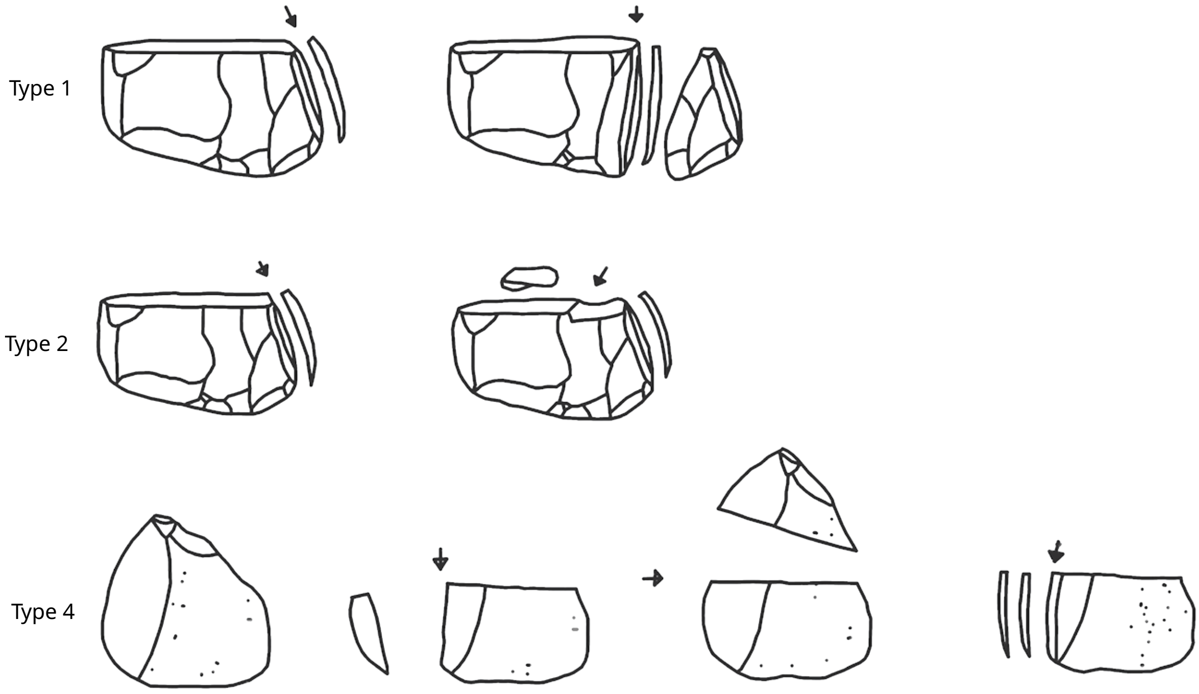


Figure 7. Types of handle cores proposed by Frandsen (2015; illustrations after *ibid.*). Type 1) Cores that have frontal rejuvenation; Type 2) Cores that have platform rejuvenation; Type 3) Handle cores with an intentionally low front (not illustrated by Frandsen (2015) and thus not included in this figure); Type 4) Blade production from a flake rather than a core.

produced (*ibid.*). Use wear studies of handle cores from Tågerup, in Scania, have supported this manner of holding (Sørensen 2003; 2006). When placed in a clamp, blade production was done from one side of the core which makes it possible to produce many blades of the same size and shape from one core without many adjustments or rejuvenation (as suggested by Knutsson 1980). Furthermore, M. Sørensen (2006) suggests that the implementation of handle cores is connected to the disappearance of the elk from Southern Scandinavia in the early Atlantic period. In relation to this, he argues that the fewer elastic elk tines were useful as pressure tools for the production of blades from conical cores, but with the extinction of the elk on Zealand, the more elastic red dear tines were used instead. This change in the characteristics of the pressure tool subsequently led to a shift in blade production which resulted in the production of shorter blades from handle cores (*ibid.*).

Frandsen also explores the dynamic nature of the handle core in his M.A. thesis from 2015. Here, he studies the variations in *chaîne opératoire* relating to the handle core and subsequently suggests a new way of characterising handle cores, based both on the technological choices made by the knapper in relation to the core rejuvenation strategy and the general core morphology. After technological studies of cores from both Zealand (Denmark) and Scania (Sweden), he suggests four handle core types (Fig. 7).

The description of the first two types is based on the rejuvenation strategies implemented by the knapper, which involved *handle cores with rejuvenation from the direction of the platform* (1) or *handle cores with rejuvenation of the platform* (2). The third type is described on a more morphological or metric basis, as *handle cores with an intentionally low front* (3). Unfortunately, a specific measurement for the core height is not stated, making the core type difficult to define, and to investigate further. The definition of the fourth type is based on the blank used for blade production. The type is described as *microblade production from a flake*

(4), and is argued to not be related to the handle core tradition. The reasons for that are not explored or described further (*ibid.*). Other studies have, however, included handle cores that are made from flakes in the general tradition of handle cores (Sjöström 2004).

Frandsen (2015) goes on to describe the *chaîne opératoire* related to the handle cores included in his study. The initial steps involve the active selection of a flint nodule that has an appropriate shape and size in order to minimise the amount of necessary core shaping. Then, the core sides are prepared through the removal of flakes using direct percussion. This is followed by the production of the platform, by removing a flake along the longer axis of the nodule. This can be done so that the nodule is split into two equally sized parts. After that, the core sides are further prepared and the platform is prepared using trimming to produce a useful angle for blade production. Blades are then produced using pressure technique (*ibid.*).

In a study of handle cores and blades from surface collections from Northern Germany (Söderlind 2018), the regional variation of the handle core technology was investigated and compared to previous research from Southern Scandinavia. The results showed clear technological similarities between the areas, relating to the shaping and preparation of the cores as well as relating to core size and the use of raw materials (flint) (*ibid.*). These similarities indicate some level of social contact between people in these areas, although the exact chronological setting in which this took place could not be investigated due to the character of the materials, as surface collections, and due to a general lack of reliable dates from these areas (*ibid.*).

Blades produced from handle cores were commonly implemented in composite tools, such as slotted bone points or daggers (*e.g.* Bille Henriksen 1976; Larsson 1978; Knutsson 2009). Although the research history related to slotted tools is extensive on its own, it also partly connects to the implementation of the handle core concept. Thus, a brief overview of previous research related to slotted bone tools is needed to provide a comprehensive understanding of the state-of-the art.

2.1.1.2 Slotted bone tools – a brief history of the research

Slotted bone/composite tools are, however, not exclusively related to the handle core concept. These finds were a part of the Mesolithic material culture within and beyond Scandinavia (Larsson 2005). Although some spatial mapping of the finds on a regional and interregional scale has been done (*e.g.* Larsson 2005), an exact distribution is made difficult by varying conditions for organic preservation. Nonetheless, the production of these tools during the Mesolithic in Scandinavia relates to the production of small and regular blades, which largely includes blades made from handle cores. Slotted bone points and other slotted tools are characterised by the presence of one or more slots with lithic inserts attached with pitch (Fig. 8).

Most technological studies of slotted bone points have focused on individual assemblages, as highlighted by Gummesson (2018, 16), which results in a fragmented view of the seemingly wide-spread technology. For instance, the production of slotted bone points in the Eastern Urals have been investigated by Savchenko (2010), in the Upper Volga region by Zhilin (1998; 2015; 2019) and Lozovskaya and Lozovski (2019), and in Scandinavia by Lidén (1942), David and Sørensen (2016) and Gummesson (2018). Although these can be very useful for regional overviews, they

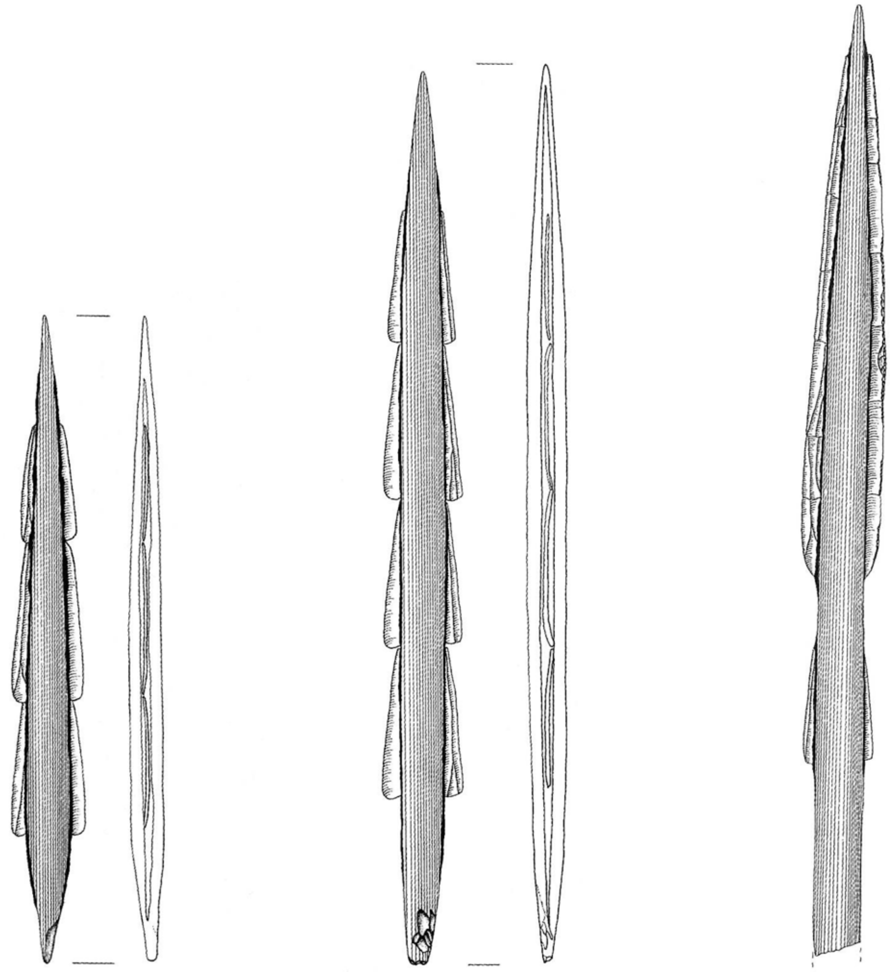


Figure 8. Examples of slotted bone points from the Tågerup site (Scania, Sweden) (after Karsten and Knarrström 2003, figs. 37 and 55).

may not allow for larger scale analyses due to the use of different methods, varying taphonomic conditions or differences in contextual settings.

A general *chaîne opératoire* for slotted bone points has been described, which was based on finds from Scania (Sweden) and Zealand (Denmark) and summarised by Knutsson (2009). In brief, blanks were first prepared using a groove-and-splinter technique. The bones were then further prepared into a point, which could be done in various ways, including the "D-method", the "F-method" and the "C-method" as described by David (2003). These methods involve different procedures for splitting, scraping and shaping the bones into points (*ibid.*).

After the general shaping of the bone point, the lateral slots are made using a burin. Pitch (often birch) was then placed in the slots and heated to soften before lithic inserts were placed in the slots. They could be placed to form a continuous line or obliquely (Knutsson 2009). A very similar process has been described for slotted bone points from the Upper Volga region (cf. Zhilin 2015), the Eastern Urals (Savchenko 2010; 2019) and in Southern Lithuania (Ivanovaitė *et al.* 2018). Many slotted bone points are found with traces of repair or reshaping, indicating that they underwent upkeep rather than being immediately replaced when broken. Inserts were also replaced when broken or fallen off (Larsson 1978; Knutsson 2009; Glørstad 2010).

Radiocarbon dating of slotted bone points indicates that they appear in Scandinavia around the same time as the introduction of the Early Mesolithic *Conical Core*

Pressure Concept (CCPC, cf. Sørensen *et al.* 2013), which was the first technology to include pressure technique within Scandinavia (dating several thousand years prior to the appearance of the handle cores). The CCPC is centred on the production of very regular blades using pressure technique, which were subsequently used as inserts in slotted bone points (David and Sørensen 2016; Jensen *et al.* 2020). In Southern Scandinavia, this bone point technology appears around 7300 cal BCE (David and Sørensen 2016). On the Late Mesolithic settlement in Motala, in Southern/Central Sweden, an assemblage of 13 slotted bone tools was dated between two main usage phases, one around 5800-5300 cal BCE and another between 4900-4500 cal BCE. The first phase was fully represented by a type of bone point with bilateral rows of inserts, while the later phase was represented by unilaterial points. This indicates a change in this technology over time in the area (Gummesson and Molin 2019). A similar chronological division between older bilateral slotted bone points and younger unilateral slotted bone points has also been suggested by Larsson (1978) based on the Ageröd assemblages from Scania.

Slotted bone points have been suggested to play a symbolic role, based on them commonly being found in wetlands and subsequently being interpreted as ritualised offerings (Knutsson *et al.* 2003). However, wetlands supply much better preservation conditions than other types of sites, which could affect these patterns. Another possibility is that bone points found in wetlands might result from hunting activities near water bodies, although slotted bone points have also been found in numerous graves throughout Northern Europe, for instance on the sites Tågerup and Barum (Scania, Sweden), Vedbaek (Zealand, Denmark) and Groß Fredenwalde (Brandenburg, Germany; see Karsten and Knarrström 2001; 2003; Kjällquist 2001; see also Kotula *et al.* 2020 for a thorough mapping of these finds), which further support their interpretation as a symbolic item or as a status symbol (Knutsson *et al.* 2003). Possibly, this could also indicate that they were considered a highly personal item. The relation of the slotted bone points to the prestigious activities associated with big game hunting has also been suggested as an important part of the understanding of these tools. The fact that many of the recovered points have ornamentation has also been interpreted as a sign that they were tools made and used with some personal meaning and care (Glørstad 2010).

2.1.1.3 Summarising the research trends related to the handle core

Several trends and shifts in paradigms are clearly visible in the history of handle core research, especially in the ways that the core is defined and understood. The patterns show a change from very descriptive morphological definitions (and implied uses) to a focus on metrics followed by a more technological approach, focusing on how the handle cores and blades were made and the processual chain that is involved in this. The research in this book also includes a technological approach for an understanding of the production and implementation of the concept. This highlights that the various perspectives involved throughout the research history have played important roles for its understanding today. In this project, however, technology will also be used in order to approach highly social perspectives, relating to mobility, contacts and transmission of knowledge.

2.1.2 Chronology and age of handle cores within Scandinavia

2.1.2.1 Southern Scandinavia

Already in the 1950s, Becker (1953) argued for the use of the handle core as a typological marker for the younger Maglemose period in Southern Scandinavia. Althin (1954, 145-46) also suggested a relative chronology where handle cores (and keeled scrapers) were included in the Maglemose setting in Denmark and Southern Sweden. The basis for using the handle cores as typological markers was the presence of them on sites that were interpreted as Maglemose (periods II and III), based on typological schemes.

In general, typological as well as technological studies from Southern Scandinavia indicate that the handle core came into use during the last part of the Maglemose period or at the start of the Kongemose period and then remained in use throughout most the Kongemose period (*e.g.* Becker 1953; Bille Henriksen 1976; Larsson 1978; 1983; Vang Petersen 1984; 2014; Andersen 1984; Sørensen 2001; 2006). Although the chronology of the different time periods has changed over time (cf. Sørensen 2017, 18), I here refer to the absolute chronology also stated by Sørensen (*ibid.*), in which the start of the Kongemose period is commonly placed at around 6500 cal BCE.

Within Southern Sweden, the chronology of the handle cores became a topic of debate between Cullberg (1972; 1974) and Welinder (1973). Welinder (1973, 15) argued that the first introduction of handle cores on the Swedish west coast is simultaneous to the introduction in Scania, at roughly 6500 cal BCE. Cullberg (1972; 1974) instead argues that the implementation of handle cores on the west coast of Sweden was not simultaneous to Southern Scandinavia, but was rather implemented by people related to the Lihult technocomplex, dating to ca. 5000 cal BCE. Cullberg further claimed that the handle core finds, used as a typological marker by Welinder, could not be clearly related to the Mesolithic layers (Cullberg 1974).

As already mentioned in 2.1.1., Vang Petersen (1984) argued that handle cores with negative platforms date to the older Kongemose period, while cores with a positive platform relate to the younger Kongemose phase. Although the technological differences that lie at the base of these interpretations are somewhat ambiguous, they become the first chronological markers related to the morphology of the handle cores. The chronological implications for positive and negative platforms persist for a long period of time, despite some substantial arguments and evidence against these patterns (Larsson 1983; Sjöström 2004; Frandsen 2015; Sørensen 2017, 44-46).

Andersen (1984) argues for a point of origin of handle cores in Zealand and Scania, and a spread to surrounding areas soon thereafter. Unfortunately, an absolute chronology is not suggested due to a lack of radiocarbon dates, but one single date from the handle core site Mosegården III resulted in a date of 5300-4732 cal BCE (6090±100 BCE).

The chronological discussion enters the 2000s through the presentation and discussion of the substantial Tågerup assemblage (Karsten and Knarrström 2001; 2003). This is one of few sites where handle cores are found in Ertebølle contexts. A morphological analysis of the handle cores from the spatially separate temporal contexts of the site has indicated that the cores from the Ertebølle contexts have a lower front (or core height) (*ibid.*). When the details of these metric differences are investigated, however, it becomes clear that the Ertebølle cores have an average height of 15-39 mm, while the Kongemose cores have an average height of 9-54 mm. This shows that the Ertebølle cores are somewhat shorter, but more importantly that they are simply less varied in size. This is likely a reflection of the much smaller assemblage from the Ertebølle contexts (27 handle cores) compared to the Kongemose assemblage (321 handle cores).

The chronology of Mesolithic Zealand, Denmark, has been further investigated by Sørensen (2001; 2006), who argues for handle cores to appear as a part of a technological process during the late phase of the Late Maglemose period. He bases his arguments on a thorough technological analysis of 23 site assemblages from the Maglemose period in Scandinavia and Northern Germany (*ibid.*). The sites have, however, only been typologically dated. A similar development is also assumed for Northern Germany (Hartz 2009).

In the already mentioned work by Frandsen (2015), some chronological and spatial patterns relating to the handle cores in Scania and Zealand were mapped. Firstly, Frandsen finds no chronological differences between handle cores with positive and negative platforms (as suggested by Vang Petersen 2014). Secondly, handle cores that are rejuvenated from the platform are used in the entire area and throughout the Kongemose period. It therefore seems to have no chronological significance. Thirdly, handle cores with "an intentionally low front" seem to appear only on sites relating to the Late Kongemose period in the entire area (*ibid.*). Possibly this brings some weight to the theory mentioned above, regarding the Tågerup assemblage, which assumes that the handle cores become lower/shorter in height towards the end of the Kongemose/Early Ertebølle periods. Finally, Frandsen (2015) found a chronological difference in the use of handle cores that showed rejuvenation of the platform. He found that this rejuvenation strategy appears in Villingebæk (Middle Kongemose) contexts in Scania, while on Zealand they appear later, in the Vedbæk phase (Late Kongemose). However, these interesting results were based on few cores and are thus not statistically reliable.

2.1.2.2 Northern Scandinavia

The chronology of handle cores became an important topic for the understanding of the first colonisation of the "Norrland" area, *i.e.* the northernmost part of Sweden. Early research from Norrland indicated that the handle core concept was the earliest lithic technology in the region and had been implemented by the first people who arrived in the area from the south after the melting of the Weichsel ice sheet (Forsberg 1989, 7). Forsberg (*ibid.*, 4) argued for a colonisation of Norrland from the south. This was also supported by Baudou (1992, 55), who also argues for the handle cores being the traces of the earliest "migration wave" of people into Northern Sweden after the last Ice Age. The suggested date for this migration wave is around 6000 BCE (8000 BP), based on radiocarbon-dated finds from the site Garaselet (Västerbotten, Sweden). However, the stratigraphy of the site was later analysed in-depth by Knutsson (1993), who showed that the earliest horizon of the site (previously accredited to the handle cores) actually relates to an earlier technological concept, which is now known as the conical core pressure concept, dating to around 8000 BP (ca. 7600-5600 cal BCE – new calibration). The handle cores on the Garaselet site are instead related to contexts dating to around 6000 BP (ca. 5500-4500 cal BCE – new calibration). However, Knutsson also points out that the dates do not necessarily relate to the introduction of handle cores in Norrland.

Olofsson (1995; 2003) has also investigated the chronology of the handle cores in Northern Sweden and argues that the tradition originates in Southern Scandinavia or the western coast of Sweden/Eastern Norway. The handle core concept is suggested to have spread through Central Scandinavia during the early Atlantic. However, Olofsson (2003) also highlights the poor contextual relationships between the handle core finds and the dated contexts, which makes the available chronology less reliable.

2.1.2.3 Southern and Eastern Norway

Handle cores in Norway were first described and used as a typological marker for the Nøstvet phase of the Mesolithic in Norway in the 1970s (Mikkelsen 1975). Mikkelsen (ibid., 31) approaches the topic of the handle core chronology in a general investigation of the chronology of the Mesolithic in Southeastern Norway. He bases this chronology on some artefacts commonly found on sites located along the prehistoric shoreline at different times throughout the Mesolithic. Sites located at an elevation of 60-40 m.a.s., containing lead artefacts such as Nøstvet axes, handle cores and keeled artefacts, were assigned to the Nøstvet phase. More specifically, he suggests an introduction of the handle core in the transition from the Middle to the Late Mesolithic (between the Tørkop and Nøstvet phases), around 6300 cal BCE (or 5400 uncal BCE) in Southeastern Norway (*ibid.*).

It is only during the last couple of decades that handle cores have been more systematically described by using technological attribute analysis (*e.g.* Melvold 2006; Damlien 2015; Eigeland 2015). Most of the analyses are, however, based on assemblages from coastal areas and less is known from the inland. Consequently, little is still known about the technology of the handle core production in general, and especially for the inland areas of Norway. A comprehensive overview has been written by Eigeland (2015), which will be briefly summarised below.

The first technological descriptions of the handle core concept from Norway comes from the site Frebergsvik, in Vestfold, Southeastern Norway (Ballin 1999, as referenced in Eigeland 2015). A part of the blade production from the site was interpreted as coming from handle cores, and some observations relating to the blade production were presented. The core fronts were prepared through trimming and blade production was done by means of indirect soft technique and/or pressure technique (*ibid.*). A later attribute study of the same assemblage included a larger portion of the blade assemblage (Eigeland 2015). In this study, Eigeland argues that the blades from the site were not a result of an intentional blade production, based both on the irregularity of the blades and on the cores lacking any distinct signs of blade detachments (*ibid.*, 65). The drawings of the cores from the site as well as some images of the so-called microblades from the site (as republished by Eigeland 2015, fig. 4.6) also leads me to the standpoint that the handle core concept cannot be confirmed at the site.

Ballin (1999, as referenced in Eigeland 2015) has also argued for a difference in technologies between Østlandet and Sørlandet (Norway), where conical cores are observed in Sørlandet, based on materials from the site Lundevågen nord R23. These cores have attributes such as 90-degree platform angles and faceted platforms. Blades were made using indirect soft technique (here meaning both punch and pressure technique). This site, along with the analysis from Frebergsvik (Sørlandet), acts as a basis for the idea that the two regions have different technological traditions, either due to regionalisation or a difference in chronology (described in more detail in Eigeland 2015).

Large-scale investigations of the Mesolithic Nøstvet phase occurred in relation to the Akershus investigations in Southeastern Norway (Berg 1995; 1997). Berg (1997) concluded that microblades were most common in the Mesolithic phase 3 (Nøstvet). Furthermore, Berg argued that conical cores and handle cores appear throughout the whole Nøstvet phase and extend into phase 4 (*ibid.*). Eigeland (2015, 66) has, however, suggested that the definitions of "blade" and "microblade" implemented in the Akershus project may have been a morphological/metric one rather than technological. Later investigations from other sites in the region, such as Trosterud 1, nonetheless, supported the interpretations by Berg (1995; 1997). This resulted in the suggestions to shift the start of the Nøstvet phase back to ca. 6500 cal BCE (7800 uncal BP). However, Eigeland (2015, 67) instead argues that the early date indicates that the site is mixed.

After further investigations of Nøstvet sites in the Oslofjord area, Ballin (1998) argues that conical cores are mainly found on Middle Mesolithic sites, while handle cores are found mainly in the Late Mesolithic, specifically in the Nøstvet phase. He further argues that any conical cores found on Nøstvet sites likely represent removed front fragments from handle cores (Ballin 1998, 123). Eigeland (2015, 67) has highlighted that these interpretations cannot be firmly based on the studied materials, as there is at least one site (Kongsdelene R71-2) which contains conical cores and related blade production but that it dates to the Nøstvet phase.

After the Svinesund project, which uncovered several Nøstvet sites in Southeastern Norway, Glørstad (2004) suggests that microblades (which are implicitly understood as related to the handle cores) increase in amounts relative to regular blades throughout the whole Nøstvet phase. He also argues that the blade technology is characteristic of the later "classic" part of the Nøstvet phase ca. 6500-6200 BP (*ibid.*, 51).

There are fewer sites from inland Norway that contain microblades and handle cores. The available assemblages are often made up of non-flint materials, such as quartzite, quartz, porphyries and sandstones, the properties of which are less understood. Nonetheless, the available materials indicate a similar technology of the handle core concept as in the coastal areas (Eigeland 2015, 68). Overall, microblade production is a strong feature of the Nøstvet phase. In Østlandet, this blade production is characterised by production from handle cores using pressure technique and direct technique. The additional implementation of conical cores is not yet clear (*ibid.*).

Knutsson (1980), Ballin (1999) and Eigeland (2015) have all suggested that exhausted handle cores may become morphologically similar to conical cores. The same has been suggested by Reitan (2016), who argued that the conical cores from the Nøstvet sites Vallermyrene 1A and 4 likely represent exhausted handle cores.

During Nøstvet phase 4 (4600-3800 BCE), handle cores, and the related blade production, are gradually replaced (or "phased out") by a concept centred around flake production from irregular platform cores (Ballin 1998; Jaksland 2001; Glørstad 2010). This is, however, only based on the one site of Gjølstad 33. Exactly what the term "phased out" refers to has been questioned by Eigeland (2015), who theorises about the reasons behind such a trend. She wonders if it simply means that fewer people started implementing the concept at this time, or if lower populations sizes are responsible. Other reasons could be that fewer blades were knapped from each core or that settlements were visited for shorter times (*ibid.*).

Phase (Norw.)	Phase (Engl.)	Age (cal BCE)	Core types
Mikrolittfasen	Microlith phase	8200-7000	Conical cores Microblade cores Bipolar cores
Trinnøksfasen	Picked adze phase	7000-5600	Conical/semiconical cores Microblade cores Bipolar cores Irregular cores Platform cores
Nøstvetøksfasen	Nøstvet adze phase	5600-4500	Handle cores Bipolar cores Platform cores Irregular cores Semiconical microblade cores
Tverrpilfasen	Transverse arrowhead phase	4500-3900	Bipolar cores Handle cores Platform cores Irregular cores

Table 1. The chronology for the Mesolithic in Norway, as proposed by Reitan (2016, 43).

Alternatively, such a trend could also relate to changes in the extent of social networks, changes in hunting practices, a shift in available resources, or a number of other reasons.

A substantial contribution to the chronological discussions of the Middle and the Late Mesolithic in Southern Norway is provided by Reitan (2016). He argues that the chronology established by Mikkelsen (1975) is out of date and that the substantial addition of recent excavations and new information gathered in the past decade allows for a revision of the chronology. Reitan (2016) proposes a new chronology (Table 1), which is based on typology and technology, shoreline displacement and new radiocarbon dates.

In the chronology by Reitan, handle cores also play a part of the Nøstvet phase, as in the chronology by Mikkelsen (1975). However, the timing of the phase is different. Reitan (2016, 33) suggests that the phase starts later, at ca. 5600 cal BCE, while Mikkelsen (1975, 31) had argued for a start around 6300 cal BCE (or 5400 uncal BCE). Reitan further states that blade production from handle cores continues to be in use throughout the Transverse arrowhead phase and only disappeared around the time of Neolithisation at 3900 BCE. This follows the absolute chronology of Mikkelsen, even though Reitan divided the phase into two sub-phases.

A clear shift is observed by Reitan (2016, 40) in the material culture around 5700-5600 cal BCE, which relates to the start of the "classic" Nøstvet phase. At that time, the clearly dominating picked adze tradition is replaced by the production of Nøstvet adzes. At the same time, the serial production of blades from handle cores becomes a central part of the technological tradition. Simultaneously, a larger flake borer is introduced and wider blades are much less common.

Eigeland (2015, 379) argues for a large technological shift in the transitional time between Nøstvet and Kjeøy phases (relating to the time around 3800 BCE, according to the periodisation by Glørstad 2002, 32). The shift relates to both an introduction of a new type of arrowhead and the end of the use of Nøstvet axes. Eigeland (2015, 379) has interpreted it as a possible time where new groups of people migrated in from Southern Sweden. A similar material trend was also noted by Reitan (2016), but he does not relate these patterns to migrations.

As a part of the Vestfoldbane project, the site Vallermyrene was investigated (site details can be found in Chapter 5) and the handle cores were technologically described (Eigeland and Fossum 2014). The cores are described as often made from larger flakes, probably from smaller beach flints. Additionally, the core platforms are described as mainly smooth but with some single cores having faceted platforms. The cores with faceted platforms are also described as very exhausted, to a higher degree than the cores with smooth platforms. Rejuvenation flakes are mainly represented by frontal- or lateral/frontal removals, but a small number of platform flakes hint at platform rejuvenation as well (*ibid.*, 41-42).

2.1.2.4 Summarising the chronology of handle cores

The handle cores have played an important role as a chronological marker for the Late Mesolithic within Scandinavia, both before and after the introduction of radiocarbon dating. Nonetheless, the chronology of the concept largely relies on a typological basis, as can be seen throughout this chapter. This is largely due to a more general issue related to the dating of flint artefacts. The artefacts themselves cannot be radiocarbon dated and instead we must rely on dating the context, where the material was found. Since these finds are not always found in clearly limited contexts, and since such contexts do not always supply datable materials, the materials can only rarely be reliably radiocarbon dated. This is discussed in detail by Olofsson (2003; cf. Chapter 2.1.2.2) with regards to the Northern Swedish assemblages, but it is a more general problem (*e.g. ibid.*; Cullberg 1974).

2.2 Mesolithic mobility and contacts

Previous research regarding mobility and contacts during the Mesolithic can be used as a basis for an understanding of the diffusion of knowledge and know-how, also relating to the handle cores. For instance, the patterns of mobility and contacts during the Early Mesolithic in Northern Europe have been thoroughly mapped and are thus well understood (*e.g.* Sørensen *et al.* 2013). Although these patterns relate to a time prior to the appearance of handle cores, they may also be relevant for later stages of the Mesolithic. Alternatively, they will help to highlight any changes from previous communication networks in Northern Europe. Additionally, previous research relating to mobility and communication routes across Northern Eurasia will be explored to aid in the understanding of these themes on a much larger spatial scale.

To understand mobility during prehistory, we must rely on the material patterns that are created by the individuals in the process. However, it is often difficult to separate materials that were moved along with people, as a part of mobility patterns, and the act of moving things as a part of exchange (cf. Close 2000). Nevertheless, the use of refitting as a method can sometimes aid in the understanding of the flux of artefacts and blanks on and between sites (Ballin 2000).

Mobility also occurs on several social scales (individual, small groups, large groups) and spatial scales (on-site, local-, regional- and interregional scales), which makes the patterns of these movements very complex to study, especially several thousand years later. Nonetheless, it can be assumed that many types of movements and mobility did occur and that they were likely a part of everyday life for hunter-gatherer communities (*e.g.* Barnard and Wendrich 2008; Knappett and Kiriatzi 2016). For instance, mobility must have played a role in aspects such as the upkeep of personal bonds and territories, accessing resources, gathering food and exploration, just to name a few. Additionally, the term "technological mobility" has been used to highlight mobility in relation to technology in order to access raw materials or movements that can be seen from the diffusion of technological knowledge and know-how (*ibid.*).

The study of mobility has often been based on the movement of materials and technologies, as will become clear from the examples below that are related to the spread of the conical core pressure concept (CCPC) in Northern Europe as well as the spread of pressure technique and pottery across Northern Eurasia.

2.2.1 Mobility and contacts within Northern Europe – the Early Mesolithic conical core pressure concept (CCPC)

In the last two decades, there has been plenty of research focused on the mobility and transmission of knowledge relating to the spread of a specific blade production concept used during the Early Mesolithic. This technological concept was centred around blade production from conical cores, using pressure technique (here referred to as the CCPC; Rankama and Kankaanpää 2007; 2008; Kankaanpää and Rankama 2011; 2012; Knutsson and Knutsson 2012; Sørensen *et al.* 2013; Kankaanpää and Rankama 2014; Damlien 2016b). This concept was implemented before the appearance of the handle core concept (here referred to as HCC), but it is relevant for an understanding of the interconnectivity of people and social groups in Northern Europe during the early part of the Mesolithic, which also may be relevant for later stages of the period, in which the handle core concept was implemented. The diffusion process for the CCPC will therefore be explored in detail in this chapter.

Two general routes of diffusion have been suggested for the spread of the Early Mesolithic CCPC into Fennoscandia (Fig. 9). The details of the spread of knowledge and know-how will be described for each region below.

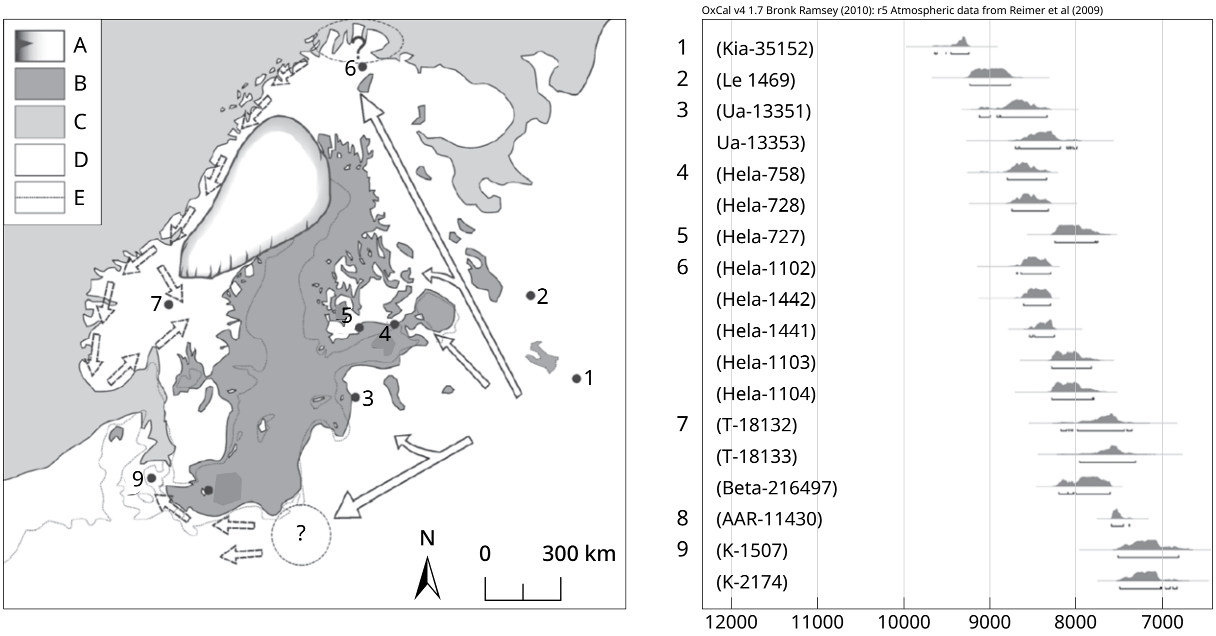


Figure 9. The diffusion of the Conical Core Pressure Concept (CCPC) in Northern Europe (after Sørensen *et al.* 2013). The numbers on the map (left) relate to the calibrated dates (right). The dates come from the sites 1) Stanovoye 4; 2) Veretye 1; 3) Pulli; 4) Saarenoja 2; 5) Ristola; 6) Sujala; 7) Knubba; 8) Gyldedenså; and 9) Ulkestrup II. The legend shows A) Fennoscandian glacier; B) Baltic Ancylus lake; C) Sea; D) Land areas around 8000 cal BC; E) Present shorelines. Calibrations were made using OxCal v.4.1.7 (Bronk Ramsey 2010; r5 Atmospheric data from Reimer *et al.* 2009).

2.2.1.1 In the Upper Volga region

The earliest appearance of the CCPC within Europe is found in the Upper Volga region in Western Russia. This area is located between the Volga-Oka interfluve and the upper parts of the Vychegda River near Moscow (Zhilin 1995; 2003; 2009; Koltsov and Zhilin 1999; Zhilin and Matiskainen 2003; Sørensen *et al.* 2013). The concept is found on several sites related to the Butovo technocomplex, but the earliest dates come from the site Stanovoye 4. Radiocarbon dates from the oldest cultural layer (IV) indicate an early implementation of the technology at around 10,000-8700 cal BCE (Zaretskaya *et al.* 2005; Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021).

The technological traits that characterise the CCPC include the production of macro- and microblades from conical/sub-conical cores with facetted platforms (Fig. 10). Blades are produced using pressure technique. Core rejuvenation is done through the removal of platform flakes as well as by removing the whole platform (resulting in a core tablet). The blades are often snapped into shorter segments and are sometimes given a lateral semi-abrupt retouch. Microburin technique is absent (Sørensen *et al.* 2013, with references). The origin of the Butovo technocomplex has been suggested to come from a Late Palaeolithic setting in the area, based on finds from the Zolotoruchye 1 site, which is dated to the end of the younger Dryas (Zhilin 2007; Hartz *et al.* 2010). Another possibility has been suggested by Sorokin (1999), who argues that the origin lies in the less explored "Resseta culture" (see disclaimer for the use of this term below). However, few similarities have been confirmed between Resseta materials and early Butovo materials. For example, a typical feature in Resseta materials is the presence of the microburin technique (Koltsov and Zhilin 1999; Sorokin 1999).

Although the term "culture" is used within the original sources as a way of grouping past societies based on material culture, I will use the term "technocomplex" in its place since it allows for a way to describe or discuss variations related to technology in different parts of the research area but without implying that people were grouped culturally, or considered a uniform social group simply due to similarities in their material culture. Historically, the use of the term "culture" for describing a social group is highly problematic since it is based on a simplified view of people in prehistory (for an extended overview, see Roberts and Vander Linden 2011), which is why it will not be used in this work.

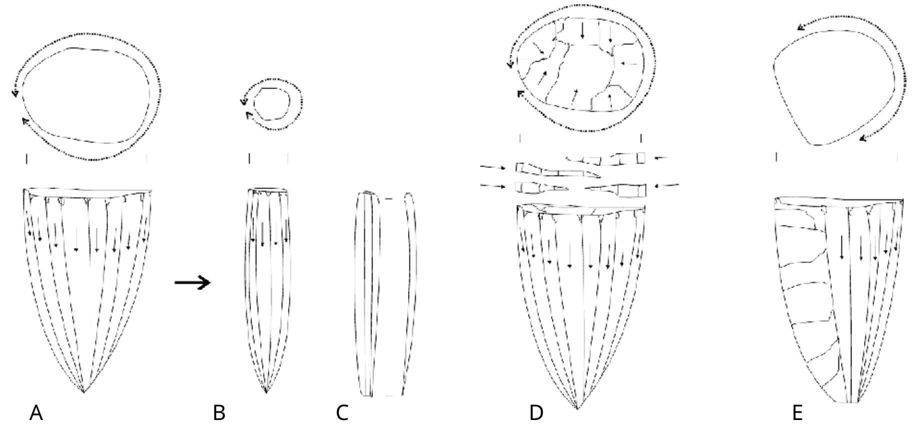


Figure 10. Schematic drawings of the CCPC and its technological variations. A-C) Cores and blade from conical/bullet-shaped cores; D) Typical rejuvenation technique – removal of flakes from platform; E) Semi-conical core (from Sørensen *et al.* 2013, 20).

2.2.1.2 In the eastern Baltic region

In the eastern Baltic area, the CCPC dates slightly later than the oldest dates in Western Russia to ca. 8600-8300 cal BCE. Here, the technological concept is often related to the Kunda technocomplex, centred in Estonia, Latvia and Lithuania (Sørensen *et al.* 2013, with sources). One of the oldest sites represented by this technological tradition is Pulli in Estonia. The assemblage from here is also characterised by regular blades, produced using pressure technique and later snapped into segments. Additionally, burins, end scrapers and tanged 'Pulli-type' points were found on site (Ostrauskas 2000; Sørensen *et al.* 2013; Šatavičius 2016, 33). The presence of microburin technique in the assemblages is, however, debated due to differences in the interpretations of these finds (*e.g.* Sorokin 1999; Ostrauskas 2000; Kriiska *et al.* 2011; 2006; Šatavičius 2016, 33-34). The varied morphology of the finds creates further difficulties in establishing or rejecting the find category within an assemblage, as discussed by Kriiska *et al.* (2011).

The origin of the Kunda technocomplex is not fully understood (cf. Ostrauskas 2000; 2006), but the technological similarities between Kunda and Butovo assemblages indicate a relationship between them. Possibly, the Butovo technocomplex or its technological origin is the origin of the later Kunda technologies in the eastern Baltic region (Sørensen *et al.* 2013). It has also been suggested that raw material variations may relate to these patterns (Kriiska *et al.* 2011). Mobility and/or contacts to surrounding regions seem to have been an important part

Figure 11. Narrow-faced blade core from Sindi-Lodja I, seen from the side (PäMu 15260/ A2553:110). (Photo: A. Kriiska; after Kriiska *et al.* 2011; © 2011 by the authors and the Archaeological Society of Finland).

of the communities living in the eastern Baltic region. On Mesolithic sites from the Pärnu Bay, local raw materials were used alongside imported raw materials from Lithuania, Poland, Belarus and Southern Scandinavia (*ibid.*). Additionally, raw materials from the Upper Volga region have been found in the eastern Baltic area, and vice versa (Zhilin 2003). Therefore, Zhilin (2003) has suggested that it is not unlikely that knowledge and know-how relating to various technologies would have spread between these areas as well.

The presence of a "narrow-faced core" from a small site assemblage from around the Pärnu Bay (Fig. 11) has been described by Kriiska *et al.* (2011). This site, named Sindi-Lodja 1, dates to around 7300-6440 cal BCE. A possible connection to the Scandinavian handle core concept has been suggested, although blade production from the narrow-faced cores from the site is also described as irregular and technologically different from the blade production from conical cores in the area (*ibid.*, 81). These characteristics do not indicate a relation to the handle core concept, since it is characterised by a rather regular blade production similar to the conical cores. Nonetheless, the presence of single-fronted/narrow-faced cores indicates that there might have been various narrow-faced core types in use in different parts of Europe during the Mesolithic.

2.2.1.3 In the southern Baltic area

In Poland, the CCPC has been observed in assemblages in various parts of the Polish lowlands on sites such as Dobra Szcz and Szczecin-Jezierzyce, Wierzchowo 6, Pomorski 3, Gudowo 3, Dobre 53, Trzebicz Mlyn, Dąbrowa Biskupia 71, Jastrzębia Góra and Deby (cf. Sørensen *et al.* 2013). These assemblages often include finds such as scaline triangular microliths made from regular blades, small conical cores used for blade production and extremely regular blades (*ibid.*). The technological character of the concept at Jastrzębia Góra 4 has been investigated in detail (Płaza and Grużdź 2010) and showed that small nodules were used to produce blade cores similar to the conical cores from Southern Scandinavia (*ibid.*). Platforms are either plain or have large facets. Technological similarities between Kunda assemblages in Eastern Poland and Maglemose technocomplex 3 in Demark also suggest contacts across Northern and Central Poland during the Early Mesolithic (Sørensen *et al.* 2013).

2.2.1.4 In Northern Fennoscandia

The technological concept relating to the CCPC has also been found in Northern Fennoscandia, on the Sujala and Fállegoahtesajeguolbba sites, in Northern Finland and Norway respectively (Rankama and Kankaanpää 2011; Sørensen *et al.* 2013). The excavated Sujala site dates to around 8500-8100 cal BCE and the archaeological materials show clear technological similarities to the Upper Volga region (Rankama and Kankaanpää 2011). The same is true for the lithic materials found on the surface of the Fállegoahtesajeguolbba site. However, the chronology of this site is solely based on shoreline curves, which date the site to sometime between 9400 and 8500 BCE (*ibid.*). The presence of the technology in Northern Fennoscandia has been explained as the result of a rapid migration of people from the Upper Volga region (Rankama and Kankaanpää 2007; 2008; Kankaanpää and Rankama 2011; 2012; 2014). The reasoning for this lies in the restricted raw material availability across the Fennoscandian shield, which stretches over large parts of Northwestern Russia and Northern Finland. This area only offers quartz, which does not lend itself well to the blade production used within the CCPC. This means that the knowledge relating to the pressure concept must have remained in the active use/memory of the people crossing the Fennoscandian shield. When these people arrived in Northern Finland, where flint-like raw materials were again available, they were able to apply their technological knowledge and know-how in these new areas (Sørensen *et al.* 2013; Kankaanpää and Rankama 2014).

The site Ristola, located in the vicinity of Sujala, as well as the site Saarenoja 2 in Southern Finland, contain imported raw materials that also show long-distance contacts between Northern/Southern Finland, Southern Lithuania/Belarus, the Upper Volga region and Estonia (*e.g.* Kriiska and Lõugas 2009; Sørensen *et al.* 2013). However, it is not clear if these contacts were direct or indirect (cf. Hertell and Tallavaara 2011). Nonetheless, it is yet another indicator that extensive communication networks were established spanning large spatial scales during the Early Mesolithic.

2.2.1.5 In Norway

From Northern Fennoscandia, the concept seems to have spread along the Norwegian coast, first towards the west and later towards the south. This is indicated by the presence of the concept on sites in the Troms area, which date to the 8th millennium BCE (Sørensen *et al.* 2013, and references). Bjerck (1986) first described the concept as a part of the "Early Microblade Tradition" extending from 9000 to 7000 BP. Later on, Bjerck (2008) describes these materials as a part of "The Middle Mesolithic Chronozone", dating to ca. 8000-6500 cal BCE.

In Southeastern Norway, the concept dates to ca. 8170-7950 cal BCE and is present on the sites Tørkop, Hovland 5 and Hovland 4 (Solheim and Damlien 2013; Damlien 2016b). One of the oldest sites in the eastern (inland) part of Norway is Knubba, which dates to sometime between 8150-7445 cal BCE (Amundsen 2007, 42). Other sites include Bjørkeli (Damlien 2010a), Stene terrasse (Damlien 2010c) and Rød terrasse (Melvold 2010). The presence of the concept in these parts, at this time, means that the diffusion southward from Northern Fennoscandia happened within one millennium (Sørensen *et al.* 2013).

The raw materials used in Eastern Norway are mainly found locally and include various types of quartz, quartzites, jasper, and porphyries, but flints are also transported and used in the southern and central areas. Additionally, raw materials have also been transported between Central Sweden and Eastern Norway (Damlien 2010c). The CCPC is also found in Central Sweden as is clear from the surface collections known as the Lannerbro collections, which are gathered along several rivers running between the two areas (Lannerbro 1991; 1992; 1997). These patterns further support the existence of social contacts, trade and/or mobility established between the areas during the Middle Mesolithic (Damlien 2010c; 2016b). However, the concept is poorly dated in Central Sweden. Only a few dates are available from the sites Limsjön (Torfgård 2014; Wehlin 2014) and Ore 527 (Söderlind 2016).

2.2.1.6 In Southern Scandinavia and Northern Germany

The CCPC also appears in Southern Scandinavia around 7000 cal BCE, relating to the Maglemose techno-group 3 on Zealand (Sørensen 2006). At this point, it is not clear if the knowledge and know-how related to the CCPC diffused via established communication networks and/or via people migrating in a southern trajectory from Central Sweden. Another option is that the CCPC also spread via a route east of the Baltic Sea, via (or from) the Baltic states, through Northern Poland and into Scandinavia from the south (Hartz *et al.* 2010; Sørensen *et al.* 2013). However, more recent technological analyses of assemblages from across Northern Germany and Southern Scandinavia (Sørensen 2018) have indicated more support for the northern route, although additional studies are needed for a more detailed technological and chronological understanding.

Within Southern Scandinavia and Northern Germany, some interesting regional patterns have been observed, related to the distribution of the CCPC. Firstly, the concept does not seem to have been a part of the cultural traditions of people across the whole area. The concept has been clearly implemented in areas of Zealand and Scania, based on the many finds related to the concept from various sites (Sørensen 2006; 2018; Sørensen *et al.* 2013). On Funen, few sites related to Maglemose techno-group 3 have been excavated, making an overview difficult. However, some finds of conical cores in surface collections from the island show that the concept was also established here, although in limited scale. Finds also confirm the concept on Bornholm. The Danish area of Jutland as well as Northern Germany, however, do not seem to have been areas where the concept was implemented, based on the lack of relevant finds (Sørensen 2018). These patterns indicate some regional patterns related to communication and contact during this part of the Mesolithic. The presence of the CCPC in Scania, Zealand and on Funen and the lack of CCPC finds on Jutland and Northern Germany generally indicate an eastern focus within Southern Scandinavia. This is also supported by the presence of finds on Bornholm (which was connected to the mainland at the time) and in Northern Poland (Sørensen 2018).

2.2.1.7 Summarising the mobility patterns in Northern Europe

Another pattern of regional variation within these areas, and beyond, relates to the manner of platform preparation used within the CCPC. Faceted platforms are most often found on conical cores from Western Russia, the eastern Baltic area, Northern Fennoscandia and Northern Sweden. Meanwhile, the presence of smooth platforms has been suggested to dominate in most areas of Southern Scandinavia as well as in Southern and Eastern Norway (Sørensen *et al.* 2013). Further regional investigations of these patterns, within Scandinavia, have suggested that the two manners of platform preparation may be related to two separate contact-spheres with a border running through Scandinavia in a southwest/northeast direction (Damlien *et al.* 2018; Sørensen 2018; Kjällquist 2020). These patterns might relate to the social organisation around different water catchment areas and the interaction between these areas (Guinard 2018). Overall, these patterns, along with patterns of raw material implementation and strontium analyses in Southern Scandinavia, indicate a complex interplay of mobility, contact and communication patterns in these regions during the Early Mesolithic (Damlien *et al.* 2018; Kjällquist and Price 2019; Kjällquist 2020).

2.2.2 Mobility and contacts across Northern Eurasia – pressure technique and pottery

Previous research has shown several diffusion processes that occurred over wide expanses, such as across Northern Eurasia, during the Palaeolithic and Mesolithic. This highlights the presence of large-scale networks and extensive mobility patterns at that time, which might also be relevant for the diffusion of single-fronted cores and the blade production related to them. Therefore, two large-scale diffusion processes will be explored in more detail in this chapter: the spread of pressure technique (2.2.2.1) and the spread of pottery in forager societies (2.2.2.2).

2.2.2.1 The spread of pressure technique

The production of blades using pressure technique in Northern Eurasia is commonly discussed in relation to wedge-shaped cores (also known as "Yubetsu cores", "Gobi-cores", "true microblade cores") due to the core type being included in the earliest assemblages from Eastern Eurasia, which include finds that were produced using pressure technique. However, pressure technique was likely implemented in relation to a whole series of core types, including conical ones and cores from flakes (Brunet 2012; Inizan 2012; Coutouly 2018). The Horoka method has also been suggested as an early blade production technique using pressure (cf. Inizan 2012; Fig. 12).

There is still no consensus among researchers regarding the exact point of origin or time for the invention of pressure technique. However, most researchers argue that one single centre of invention should be assumed. Additionally, many agree that the oldest remains come from somewhere in a poorly defined area that includes modern day Mongolia, Southern China and Southeastern Siberia (Smith 1974; Brunet 2012; Inizan 2012). Finds of microblade pressure debitage from this area date to around 18,000 BCE and the technology is assumed to have spread towards the east, west and south during the last glacial maximum soon after its invention (cf. Inizan 2012, more below).

However, some researchers instead argue for an invention somewhere in the areas of today's Korea, Hokkaido (Japan), Sakhalin (Eastern Russia) or China, where the oldest date indicates a starting chronology around 28,000-23,000 cal BCE (Graf 2009; Coutouly 2018). The reasons behind these significantly different theories relating to the initial history of pressure technique likely relate to several issues, as discussed by Coutouly (2018). He suggests that the research relating to the spread of pressure technique, and microblade technology, is characterised by both a lack of consistency in the use of the terms microblade/microblade core along with several chronological issues. The issues relating to terminology include a highly varied or undisclosed use of the term microblade and microblade core (*ibid.*). He highlights, after a substantial review of known literature, that the term "microblade", for example, is used to describe a variety of things, including smaller blades made from indirect/pressure technique, blades from conical or wedge-shaped cores, "very small, narrow blades", smaller and regular blades, and blades smaller than a certain size or simply based on the metric rule that it should be twice as long as it is wide (Coutouly 2018, 822-823). Few of these definitions of microblades, and subsequently the microblade cores, are based on any technological grounds, which is clearly an issue when investigating the origin of pressure technique.

Issues regarding the chronology of the concept come down to poor scientific standards for publishing data, in general. Many researchers publish results claiming the presence of pressure technique within an assemblage without publishing any data regarding the finds (*ibid.*). Additionally, there are not enough available dates for such a large area (Northern Eurasia) to clearly understand the diffusion process. Furthermore, dates are often published without information regarding context, sample materials or other source critical aspects. The review by Coutouly

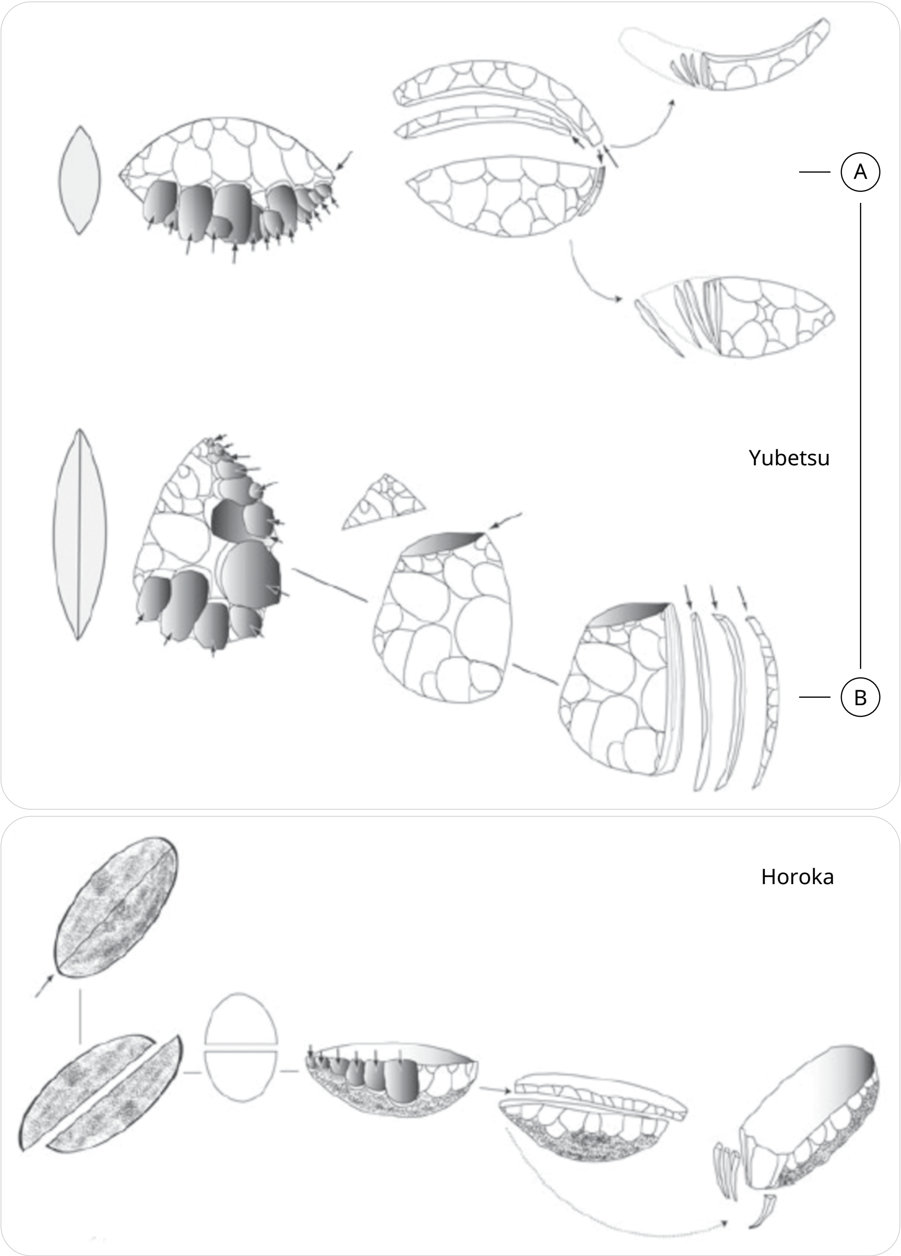


Figure 12. Yubetsu method, with modes A and B (top) and Horoka method (bottom) for core preparation and blade production techniques (after Inizan 2012, 32).

(2018) highlights several issues that are general to archaeology and specific to the use of pressure technique. To understand the exact origin of this technology and its diffusion across Northern Eurasia, we need more detailed studies which focus on good scientific practice, including the publication of raw data, reliable radiocarbon dating and regional technological studies.

A probable area of origin is suggested by Coutouly (2018), based on the currently available data. This area stretches over Korea, Hokkaido, Sakhalin and China and the earliest reliable dates suggest a starting chronology from ca. 30,000 to 25,000 cal BP. A more specific time and place is not possible before more data becomes available from these areas, and more data is also needed before a detailed trajectory of diffusion can be proposed. However, the use of pressure technique seems to have spread in several directions, including Central Asia, America and later to Europe and Africa (*ibid.*, 841).

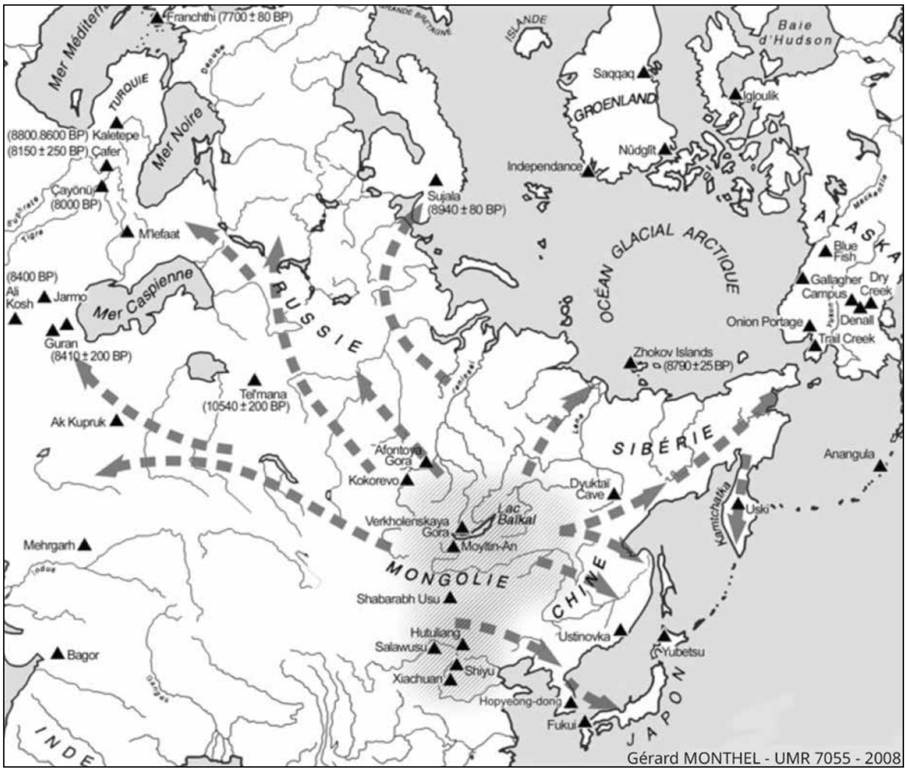


Figure 13. Origin area of pressure technique (hatched area) and hypothetical diffusion routes (arrows) across Northern Eurasia (from Inizan 2012, 36).

Another origin and a different trajectory have also been suggested (Smith 1974; Brunet 2012; Inizan 2012), starting somewhere within modern day Mongolia, Northern China and Southeastern Siberia. Migrations and diffusion of knowledge would have resulted in a spread towards the east, west and south (Fig. 13). The eastern route is described as rapid, first arriving in modern day Japan soon after its initial invention. Furthermore, the technology would have spread to Kamchatka around 10,000 BCE (Smith 1974). From here, pressure technique spread into North America, arriving around 8000 BCE (Smith 1974; Inizan 2012; Takakura 2012). This is supported by technological similarities between materials in Alaska and Mongolia as well as gradual radiocarbon dates in a west-east trajectory (Smith 1974). From Alaska, the technology appears to have slowly spread further east and south in North America (Desrosiers and Sørensen 2012). Although this theory is based on available data, it lacks a discussion regarding source criticism.

In the Near East, pressure technique is argued to have appeared suddenly around 9000 cal BCE. After two millennia, it is also established in Eastern Anatolia, from where it spread to neighbouring areas in modern Iran, Iraq, Afghanistan and Syria during the following two millennia (Chabot and Pelegrin 2012). Here, pressure technique was used for blade production during the Pre-Pottery Neolithic. The technique was implemented in various technologies, which included the use of a crutch and/or a lever to produce different sized blades. The cores from which the blades were produced were conical, sub-conical and naviform (or boat shaped/wedge shaped). For this, raw materials, such as flint and obsidian, were used (Binder and Balkan-Atli 2001; Binder 2007; Altınbilek-Algül *et al.* 2012; Chabot and Pelegrin 2012).

Recent excavations in Western Iran and the site Chogha Golan have resulted in a flint assemblage characterised by blade production using pressure technique (see Zeidi and Conard 2013). The archaeological layers (I and II) containing these finds have been dated to 8200-7600 cal BCE (Conard and Zeidi 2013), although only single dates from each layer were documented and the relationships between dates and finds are not discussed. One date is also based on an unknown charcoal sample, which further makes the chronology unreliable at this point.

This knowledge subsequently spread from the Middle East to various areas around the Mediterranean, including Italy, Greece and the Iberian Peninsula. Additionally, pressure technique spread to Algeria in North Africa. The technique in Algeria is found in the Upper Caspian tradition and dates to the 7-6th millennium BCE (cf. Morgado and Pelegrin 2012).

The use of pressure technique for blade production is assumed to have spread from Northeastern Eurasia in a north-western trajectory, across today's Russia and into Europe. The basis for this assumption is an observed gradual spread of the technology from east to west as supported by radiocarbon dates (although few). Another support for this theory of technological spread is that pressure technique seems to appear in Northeastern Europe alongside the same core types (wedge-shaped or conical cores) that were found in the east (Inizan 2012; Gronenborn 2017).

Gronenborn (2017) further argues for large-scale and long-term networks across Western Eurasia, partly based on the relative genetic homogeneity of hunter-gatherers in these areas along with some discussions regarding technological similarities within them. However, the results and discussion by Gronenborn (*ibid.*) are partially flawed due to a lack of source critical review of the genetic data and its relation to the archaeological data. Regarding this, it lacks a discussion concerning the implication that genetic similarity is connected to socio-cultural similarity (which is highly problematic). Additionally, the article is missing several important publications from the last decade regarding Mesolithic migrations within Northern Europe (*e.g.* Rankama and Kankaanpää 2008; 2011; Kankaanpää and Rankama 2014; Sørensen *et al.* 2013; Damlien 2016a; 2016b).

Overall, more well-published data is needed from across Northern Eurasia before a clear consensus can be reached for a reliable discussion regarding these large-scale migrations, social traditions and networks.

2.2.2.2 The spread of pottery in Northern Eurasia

The spread of pottery across Northern Eurasia shows another example of mobility, contacts and transmission of knowledge between hunter-gatherer groups on a large spatial scale (Jordan *et al.* 2016; Fig. 14).

Literature from Western, Central and Southern Europe often refers to the onset of the Neolithic period as an economic change, from hunting/gathering/fishing subsistence strategies to more production-related strategies such as farming (cf. Cilingiroglu 2005; Piezonka 2015). However, the start of the Neolithic period in the literature from Russia, Belarus and the Ukraine is connected to the first implementation of pottery (as discussed, *e.g.*, Piezonka 2015, 275). The use of pottery in societies with an economic focus on hunting, gathering and fishing, characterised by a non-sedentary lifestyle, is thus understood as a part of a Neolithic life-way both east and west of the Urals and into the eastern Baltic area (Piezonka 2015; Piezonka *et al.* 2017).

The first appearance of pottery is found in modern China, ca. 18,000 cal BCE (Wu *et al.* 2012), and soon afterwards it is also found in Japan and the Russian Far East (Jordan *et al.* 2016; Piezonka *et al.* 2020). Analyses of food crusts on the

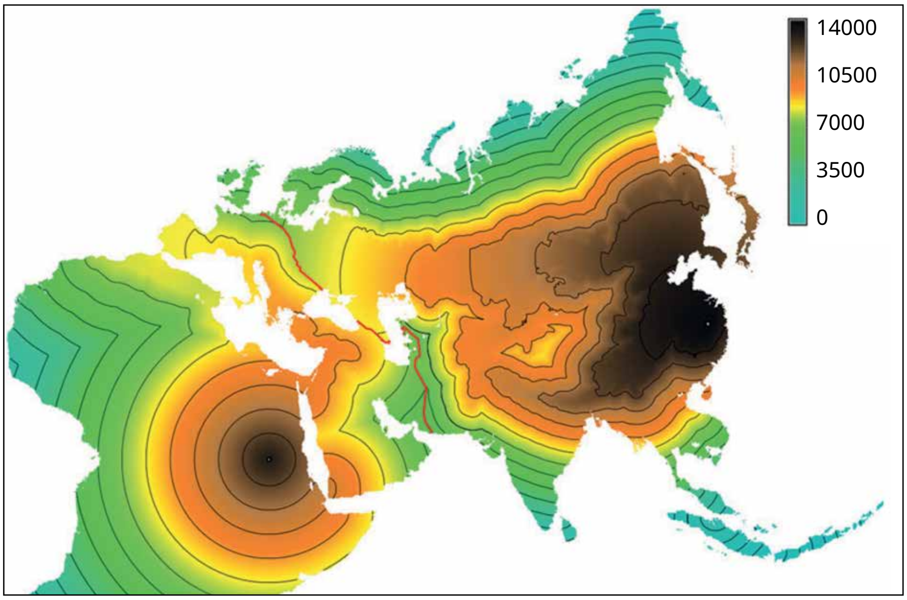


Figure 14. Modelling of suggested diffusion of pottery across Northern Eurasia (from Jordan *et al.* 2016, 599).

early pottery in the Far East have shown that the use of the pots is related to fish processing (Gibbs *et al.* 2017). A gradual spread of the technologies involved in pottery making from the Far East towards Western Siberia and the Urals has been suggested by Jordan *et al.* (2016), although a substantial chronological hiatus in the Baikal region of several millennia has been pointed out (Piezonka *et al.* 2020). More studies across Siberia are needed to investigate these patterns. Additionally, analyses of food crusts from pottery in the Urals and Western Siberia show a more diverse use of the vessels, not only for the processing of fish (*ibid.*).

Within Northern Europe, several lines of tradition of hunter-gatherer pottery have been observed, as mapped by Piezonka (2015). These different pottery-making traditions come with their own dynamic trajectories which relate to social and cultural traditions that also develop and change over the course of time and in relation to other pottery traditions along those trajectories (cf. Piezonka 2015; Mazurkevich and Dolbunova 2015). Three general trajectories have been identified by Piezonka (2015). The first tradition spread from the forest steppe east to the Middle Volga region of Western Russia and dates to the end of the 7th millennium in Central Russia. The ceramics had pointed or flat bases and were modestly decorated or not decorated. Any decorations consisted of small stabs or notches. The diffusion of this tradition has a westward trajectory and ends up as the foundation of Narva pottery in the eastern Baltic region (*ibid.*; Piezonka *et al.* 2020).

A second diffusion process starts during the second half of the 6th millennium BCE, north of the Black Sea, in relation to the Dnieper-Donets cultural sphere. The pottery often has pointed bases and mineral or organic temper. This pottery tradition is diffused northward and ends up influencing the development of the Narva pottery tradition and other nearby groups. This tradition, after its interplay with the Narva pottery tradition, subsequently diffuses westward and ends up representing the foundation for pottery in hunter-gatherer groups in Western Europe, including Ertebølle pottery (Piezonka 2015; Piezonka *et al.* 2020).

A third trajectory of pottery seemingly starts in the Volga-Kama region west of the Urals and appears to spread to the north and west during the first half of the 6th millennium BCE. This pottery is decorated with stabs and stamps. Further technological development occurred in the Middle Upper Volga region and subsequently diffused northwards towards Lake Onega. This created the foundation for the northern Comb ceramics, which relate to traditions in Karelia and Finland. At the end of the 6th millennium BCE, this northern tradition changes due to influences from an eastern strand of the same Comb Ceramic related sphere. At the end of the 5th millennium BCE, related ceramic traditions had spread towards the south and end up influencing and partly influencing the Narva ceramic tradition in the Baltic area (Piezonka 2015).

2.2.2.3 Summarising large-scale mobility and contacts over Northern Eurasia in prehistory

In summary, the archaeological materials across Northern Eurasia suggest established large-scale social networks across this large area (Smith 1974; Inizan 2012; Piezonka 2015; Jordan *et al.* 2016; Gronenborn 2017; Piezonka *et al.* 2020). Additionally, social networks seem to have been established between Asia and the Middle East/North Africa, as seen by the spread of pressure technique (cf. Smith 1974; Inizan 2012; Jordan *et al.* 2016). However, further studies are needed over the large expanse of Siberia and across the Urals to establish a clear chronology relating to the spread of both pressure technique (as suggested by Coutouly 2018) and pottery making (Piezonka *et al.* 2020). Furthermore, these large-scale spatial studies need to pay attention to problems related to a lack of consensus regarding terms and patterns associated with the research focus over time, *etc.* (although these are issues present in archaeological research in general). The situation is also made more difficult because of the heterogenous character of available data.

Nonetheless, more technological and chronological studies would further the understanding of the transmission of knowledge, mobility and contacts on a Northern Eurasian scale. More data on these topics could aid in the understanding of these patterns, not only on a large spatial scale but would also help to explain the regional and local patterns that are established within these vast expanses. This includes an understanding of the social contexts involved in the transmission of knowledge and know-how of handle cores and wedge-shaped cores in Northern Europe.

2.3 Mesolithic landscapes

To understand the diffusion process of the handle core technology and how it relates to the changing landscapes during the Mesolithic in Northern Europe, a general overview of some of the important changes will be discussed. This is not to assume that correlation also means a causation, but rather to investigate the societal, economic and environmental contexts that people, implementing the handle core concept, may have experienced in relation to the dynamic landscapes at the time.

Although the chronology of the diffusion related to the handle core concept is unclear, it is generally assumed to have taken place during the Atlantic chronozone, sometime between 7000-4000 cal BCE, which will be used as a broad time frame for the landscape and environmental mapping in this chapter.

It is important to note that the landscapes which people inhabited are also enculturated (*e.g.* Bird-David 1990; Descola 2014; Harris and Cipolla 2017, 152-70), meaning that people living during the Mesolithic (for example) would been a part of a mutual relationship with their surroundings, taking part in the landscape changes occurring at this time. The environmental and climatic changes during the Atlantic chronozone are far too extensive and complex to be explored in detail in this chapter. Instead, the focus will lie on a selection of events that took place during this time that caused an effect on temperatures, physical landscapes and related effects in the flora and fauna at the time before, during and after the implementation of the handle cores in Northern Europe. Additionally, the availability of lithic resources will be presented, as it is highly relevant for the implementation of the concept.

2.3.1 Changing climate, changing landscapes

At the start of the Atlantic period, the Palaeolithic and Early Mesolithic landscapes had already been under constant and large-scale change for several millennia. The melting of the *Weichselian* ice sheet, which had covered large parts of Northern Europe, had resulted in some areas becoming submerged (for instance Southern Scandinavia) by the start of the Atlantic chronozone, while others were exposed from the sea (such as Northern Scandinavia) due to isostatic and eustatic effects (Fig. 15; Björck 1995; Stroeven *et al.* 2016; Hansson 2018), the details of which will be explored below.

During the Mesolithic, this led to a variety of landscape changes across Northern Europe. These changes were not constant and would have created a highly dynamic landscape for the people living in it (cf. Björck 2008). At the time around 6500 cal BCE, the Baltic Sea gradually changed from the Ancylus lake stage, which was characterised by fresh water, to the Littorina sea stage, which was characterised by saline water. This change was more rapid in the southern parts of the Baltic Sea, while areas further north remained fresh water areas longer.

Figure 15. Map showing the shorelines around the Baltic Sea at present and during the Atlantic (ca. 6500-4500 cal BCE). The prehistoric shorelines (map: Atlantic 2 version 1.0.2) were compiled by ZBSA (after Björck 1995; Weaver *et al.* 2003; Påsse and Andersson 2005; Edwards and Brooks 2008; Brooks *et al.* 2011; Moscon *et al.* 2015; Stroeven *et al.* 2016; Cohen *et al.* 2017; Harff *et al.* 2017; Lericolais 2017; Subetto *et al.* 2017; Seguinot *et al.* 2018). Modern shorelines are from ©OpenStreetMap contributors, available under the Open Database License).

For instance, in the Stockholm area, the water was not brackish until ca. 6000 cal BCE. The Gulf of Finland seems to have had brackish/saline waters already at around 6400 cal BCE. However, the dates for these saline changes come with some uncertainties and precision-related issues (Berglund *et al.* 2005). Salinity increased throughout the Littorina stage of the Baltic Sea, likely due to both higher sea water levels and an increased influx of salt water via the increasingly wide Danish Strait, until between 4800-4200 cal BCE, when levels again started to decrease (*ibid.*). This pattern was made more complex by various transgression/regression fluctuations between 6000-2500 cal BCE (cf. Yu 2003; Berglund *et al.* 2005). Additionally, sediment stratigraphies from Blekinge, in Southwest Sweden, suggest a sudden regression/transgression event around 6200-6100 cal BCE, interpreted as an event known as the Storegga tsunami (Berglund *et al.* 2005; Weninger *et al.* 2008).

The time around 6200 cal BCE also corresponds to the 8.2-event (BP), which was characterised in Northern Europe by a climatic cooling period that lasted for ca. 160 years before temperatures slowly went back to the previous Atlantic levels (Kobashi *et al.* 2007). The event was likely triggered by the drainage of glacial lakes in North America into the North Atlantic which in turn caused a disruption in the water circulation in the Atlantic. Since this circulatory system plays an important role in the global climactic system, this resulted in much cooler temperatures in the northern hemisphere. It is very likely that populations living at this time would have been affected by these sudden changes in temperature, with possible changes in settlement patterns, subsistence strategies and technologies as a result (Manninen 2014).

At around the same time, a massive landscape change occurs in Southern Scandinavia, related to the creation of the Danish isles, *i.e.* the cut-off of these landmasses from mainland Northern Germany and Southern Sweden, which had severe regional repercussions for faunal availability (see 2.3.3.; Björck 1995; Aaris-Sørensen 2009).

2.3.2 Forest coverage

The warmer temperatures in the Early Holocene, along with higher humidity, gave way for a fast colonisation of plants and trees into the newly uncovered areas of Northern Europe. Between ca. 6500-4500 cal BCE, the forests of Northern Europe developed quickly in the warmer temperatures and higher humidity. At the start of the time span, around 4500 BCE, birch trees began to spread across the previously ice-covered areas of Scandinavia and ca. 500 years later pine trees followed. Across Northern Europe, the existing forests became denser and areas with originally little forest cover became lush, especially in Central and Eastern Europe (Fig. 16). In this process, light-loving trees and plants were forced away by large-canopy trees such as pine and various deciduous trees (Zanon *et al.* 2018). The same trends have been confirmed for Western Russia (Zhilin 2008).

The generally dense forests that were established in Northern Europe during that time were broken up by small areas of more open landscapes, managed by beavers, large herbivores and in part by forest fires. In these areas, a larger variety of herbs, shrubs, and light-loving plants and trees would have thrived. Landscapes around lakes and rivers and on very poor soils would have also remained more open (cf. Svenning 2002).

The time that follows 4500 cal BCE was instead characterised by a decline in forest cover, possibly because of the cooler temperatures at that time, or perhaps

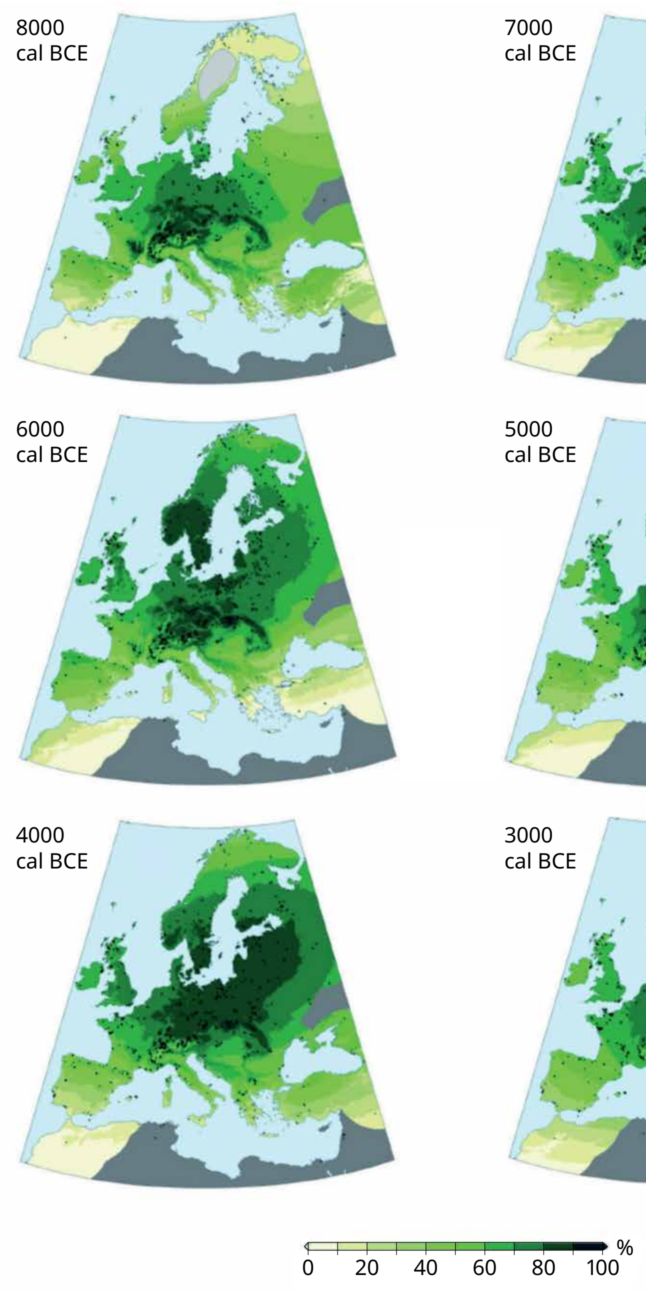


Figure 16. Forest coverage development between 8000 and 3000 BCE (after Zanon *et al.* 2018, 14-15).

related to human deforestation during the Neolithic, or a combination of the two (Zanon *et al.* 2018).

2.3.3 Fauna variability

The variety of fauna across Northern Europe is rather homogenous since it was adapted to an ecosystem characterised by similarly dense forested environments. Large mammals include elk (*Alces alces*), brown bear (*Ursus arctos*), roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), beaver (*Castor fiber*), aurochs (*Bos primigenius*), wild boar (*Sus scrofa*), lynx (*Lynx lynx*) and wildcat (*Felis silvestris*) (Aaris-Sørensen 2009).

Figure 17. The Danish isles of Zealand and Funen are cut off from mainland Europe at ca. 6200 (cf. Aaris-Sørensen 2009, 48). The prehistoric shorelines (map: Atlantic 2 version 1.0.2) were compiled by ZBSA (after Björck 1995; Weaver *et al.* 2003; Påsse/Andersson 2005; Edwards/Brooks 2008; Brooks *et al.* 2011; Moscon *et al.* 2015; Cohen *et al.* 2017; Harff *et al.* 2017; Lericolais 2017; Subetto *et al.* 2017; Stroeven *et al.* 2016; Seguinot *et al.* 2018. Modern shorelines are from ©OpenStreetMap contributors, available under the Open Database License).

In Scandinavia, the time period between ca. 7000-4000 cal BCE is also characterised by a generally stable species presence. However, certain areas of Southern Scandinavia undergo species losses in relation to the drastic landscape changes around 6200 cal BCE, when the Danish islands Zealand and Fyn are cut off from mainland Europe (Fig. 17). Soon thereafter, the extinction of several terrestrial species occurred on Zealand, including brown bear, western polecat, badger, lynx, elk and aurochs. Around the same time, Fyn also experienced a similar extinction of species, although only lynx, badger and the brown bear are included (Aaris-Sørensen 2009). Zealand also seems to experience an increased red deer population, possibly due to the lower competition of elk and aurochs as well as due to changes in the biotope on the island (Magnell 2017). Island faunas are generally more vulnerable to change since immigration becomes prohibited (Aaris-Sørensen 2009). An additional reason for the decline of these species on the Danish islands could relate to changes in vegetation, from coniferous forests to broad-leafed forests that came with the warmer and more humid climate in the Atlantic (Magnell 2017).

The changes in salinity also lead to an increase in the diversity of marine fauna with a possible maximum richness between 5500-4000 cal BCE (Björck 2008). Fish was an important food source during the Mesolithic. It has long been assumed that fishing became an important part of subsistence only in the later stages of the Mesolithic, especially during the Ertebølle phase (*e.g.* Björck 2008), but recent research has highlighted the importance of fishing in the earlier phases of the Mesolithic/Early Holocene as well (Hansson *et al.* 2018; Boethius 2018; Boethius *et al.* 2021). The amount of fish included in the diet, nonetheless, shows regional and temporal patterns (Boethius 2018; Meadows *et al.* 2018), but osteological and genetic research has indicated that the biodiverse marine environments in the Southern Baltic Sea may have played an important role for populating the area in the Early Holocene. This suggests that people came to the area to access these marine resources, which in turn led to the genetic diversity that can be seen traced in the Early Mesolithic populations (Günther *et al.* 2018; Boethius 2018, 111).

A study of species diversity on Early Mesolithic inland sites across Northern Europe (Robson and Ritchie 2019) has highlighted the importance of freshwater fishing. The same pattern was shown by Boethius (2018), who suggests that freshwater bodies were preferred during the Mesolithic due to their flexibility of use during different seasons and additional advantages during spawning periods (*ibid.*, 106). Nonetheless, the presence of marine species and seals at Mesolithic sites shows that marine environments were also used, possibly to a larger extent in the later stages of the Mesolithic (Eriksson and Magnell 2001). Fishing was done with the help of artefacts and technologies such as weirs, nets and traps, hooks, leisters, boats and paddles (Karsten and Knarrström 2003, 55-56; Hansson *et al.* 2018; Boethius *et al.* 2021). Few material remains from the preservation and storage of fish exist, however, one such example was found at the Early Mesolithic site Norje Sunnansund in Southwestern Sweden (Kjällquist *et al.* 2016; Boethius 2018).

In summary, the landscapes during the Atlantic were highly dynamic and characterised by both new and lost land areas around the Baltic Sea, changing temperatures, humidity, the increasingly lush forests and regional extinction events.

2.3.4 Lithic variability

The availability of lithic materials varies across Northern Europe, which is also reflected in the implementation of different raw materials during the Mesolithic. In addition to flint and quartz, which have regional availability, other raw materials appear sporadically across Northern Europe, including porphyries, quartzites, cherts and slates.

2.3.4.1 Scandinavia and Northern Germany

In Southern Scandinavia, flint is found as both primary and secondary sources, with the latter as beach flints and moraine deposits. Primary sources of Southern Scandinavian flints can be found in chalk (bedrock) areas in Southern Scania, Northern Jutland and Eastern Zealand (Fig. 18). These regional flints consist of different variants of Senonian or Danian flints. A local flint variety, which is known as Kristianstads flint, is also found in Northeastern Scania. In Northern Germany, Baltic flints can be found mainly as secondary deposits of large nodules in the moraine and on beaches (Högberg and Olausson 2007), although primary sources of flint can also be found on the island of Rügen, in Northern Germany.

A common raw material, found across most of Fennoscandia, is also quartz. Quartz is found both as moraine deposits in underground quartz veins and occasionally in quarries (Lindgren 2004, 198-99). Quartz was commonly used for tools during the Mesolithic (Lindgren 2004, 23-26; Gustafsson Gillbrand 2018, 13, 19-21), especially in areas that lack natural sources of flint. Although the fracture patterns differ compared to flint, it can nonetheless be used for blade production (Lindgren 2004; Knutsson 2009).

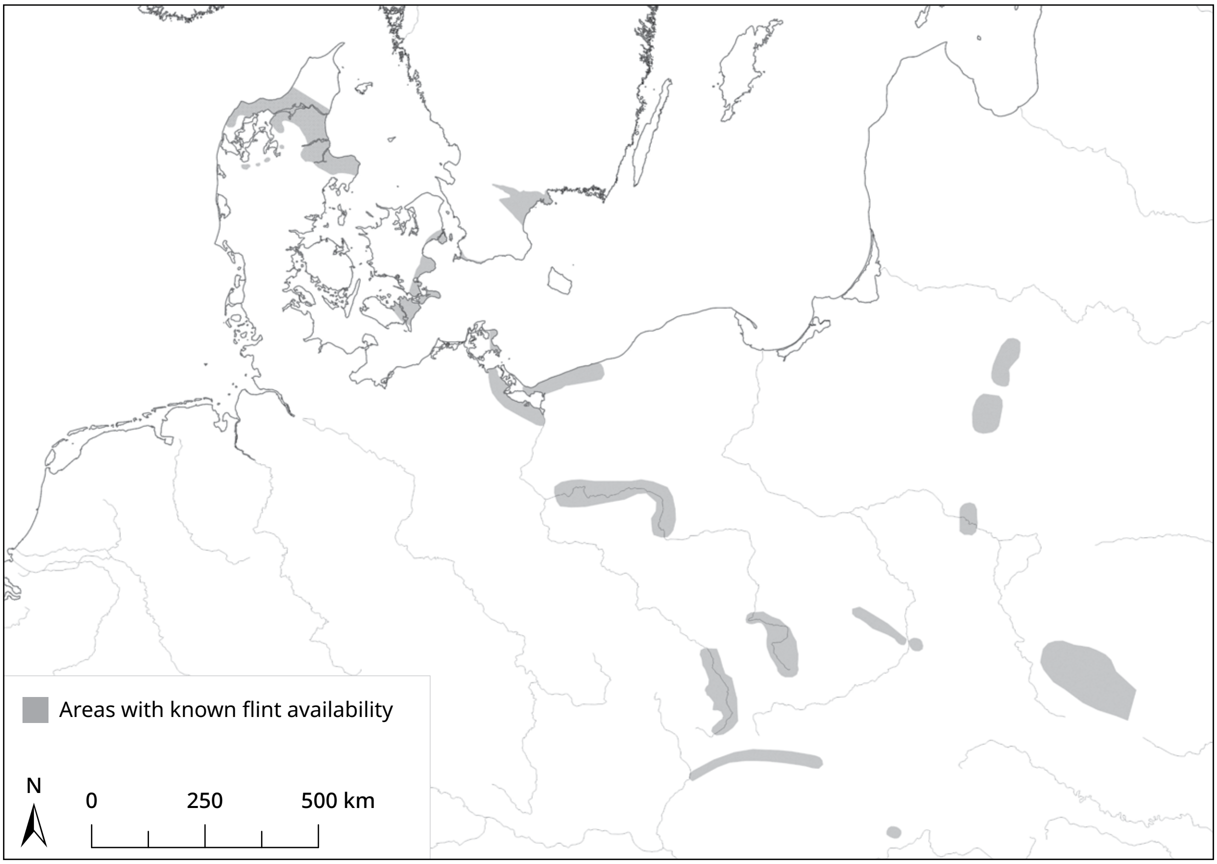


Figure 18. Areas with known flint availability in Southern Scandinavia and continental Northern Europe (compiled from Vang Petersen 2014, 23; Wiśniewski 2016).

One area with an especially diverse raw material availability exists in Central Scandinavia where the Transscandinavian Igneous Belt (Gorbatschev 2004) is located near the surface, allowing for access to various porphyries, tuffs, jasper, quartzites and quartzes, *etc*. These raw materials were commonly used for tool production in the region during the Mesolithic. Interregional exchange of these raw materials has also been supported within Central Scandinavia (*e.g.* Taffinder 1998; Damlien 2010c; Gustafsson Gillbrand 2018).

The southernmost distribution of Scandinavian flint goes through Northern Germany (Fig. 2). A mapping of registered handle core sites across Scandinavia and Northern Germany shows some overlap between the distribution of handle cores and Scandinavian flint (Söderlind *et al.* 2023).

2.3.4.2 Northern Poland

There is a variety of flints available locally in Northern Poland (Fig. 18), including Pomeranian flint which is a version of erratic moraine Baltic flint. While Baltic flint is available in most of Northern, Central and Northwestern Poland, Pomeranian flint is available in the central and northern parts. Both were used as a raw material for tools during the Stone Age in these areas of Poland (Płaza and Grużdź 2010; Sobkowiak-Tabaka *et al.* 2016; Wiśniewski 2016). The nodules are round and small (ca. 5-6 cm in diameter), which does not allow for especially large artefacts, although it is assumed that Pomeranian flints with a size of up to 9 cm may have been available during the Stone Age (Płaza and Grużdź 2010).

However, the implementation of raw materials for stone tools in Northern Poland was not stable over time. In the Early Mesolithic, erratic or Pomeranian flints were mainly used in Northern and Central Poland. In the Late Mesolithic, brown chocolate flint was instead exported and used in these areas. Chocolate flint is only available naturally in central, southern and eastern areas of Poland and was especially important for the people related to the Janislawice culture (Masojć 2016).

2.3.4.3 Lithuania and the Baltic states

In Southern Lithuania, flint has been mined from the Late Palaeolithic onward. Areas with known flint mines include the districts of Alytus and Varėna, located in Southern Lithuania. The flint is black/brownish and of high quality, found as concretions in pieces of chalk washed up by melting glacial waters. Some of these concretions can be found just under ground level (Baltrūnas *et al.* 2006; Šatavičius 2016). There is a correlation between flint artefacts and areas with flint sources, although this pattern is likely also due to a research focus in this area (Šatavičius 2016, 23). The remaining parts of Lithuania contain only poor-quality flints of small size nodules. Nonetheless, some exchange of raw materials from the south seems to have occurred during the Early Mesolithic. This is, however, lacking during the later stages of the Mesolithic (*ibid.*, 31).

Two types of flint are known from Early Mesolithic assemblages in Latvia and Estonia. One of them is the already mentioned flint from Southern Lithuania. The other type of flint occurs naturally in Estonia and consists of small, mainly grey, light brown or yellowish pebbles and nodules of poor knapping quality (Kriiska and Lõugas 2009; Kriiska *et al.* 2011). The south Lithuanian flint seems to have been widely used in Latvia and Estonia during the Early Mesolithic and less so during the later stages of the Mesolithic (Kriiska and Lõugas 2009).

2.3.4.4 Western Russia – Upper Volga region

In the Upper Volga region, different types of flint are available locally. One of them is a high-quality Carboniferous flint, common in the westernmost parts of the Upper Volga region. Additionally, low-quality Carboniferous flints are readily available in moraine deposits across the eastern European forest zone, including the central part of the Upper Volga River Basin. These are, however, characterised by cracks, which is bad for knapping. It was, nonetheless, used in areas that lack good-quality flints. Small good-quality flint pebbles from alluvial deposits were also used for tools (Zhilin 2006).

The presence of some single artefacts made of flint from Southern Lithuania/Belarus within Butovo assemblages have been interpreted as indicative of contacts and/or exchange between these areas (Zhilin 2003; 2006). Local variants of flints within the Upper Volga region also seem to have been moved across larger areas (Zhilin 2006).

The areas west/north-west of the Upper Volga region also contain quartz. Additionally, silicified sandstone, slate, limestone and quartzites have also been implemented. Nonetheless, the abundance of flint in the Upper Volga region made this the most used raw material during the Mesolithic (Zhilin 2006).

3 Theoretical framework

Since technology is a central part of this study, it is necessary to explore its aspects in detail. A search for the term “technology” in dictionaries resulted in various definitions (all accessed on 23.07.2021):

- ‘… the practical application of knowledge especially in a particular area’
- ‘… a capability given by the practical application of knowledge’
- ‘… a manner of accomplishing a task especially using technical processes, methods, or knowledge’ (Merriam-Webster dictionary)
- ‘Technology, the application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment’ (Encyclopaedia Britannica)
- ‘… scientific knowledge used in practical ways in industry, for example in designing new machines’ (Oxford Advanced Learners Dictionary)
- ‘… (the study of) science applied to practical, (especially industrial) purposes’ (Cambridge Dictionary)
- ‘Technology refers to methods, systems, and devices which are the result of scientific knowledge being used for practical purposes.’ (Collins dictionary)

Based on the definitions from these dictionaries, we can conclude that the term technology commonly refers to one of the following: 1) practice/practical applications, 2) knowledge (practical or scientific), 3) methods and 4) industry/machines. These definitions relate to a modern idea of the term, which is often focused on practical knowledge and related methods, often of industrial or mechanical sectors. In this chapter, I will, however, explore the concept with a focus on the social implication of the term. The reasons for exploring the more social aspects of the term include the need of having a common ground for both social interaction and practical application, represented through the physical materials that are involved in technologies.

The theoretical framework used here will focus on technology and its social aspects, as a social phenomenon (3.1) and its role in transmission of knowledge and diffusion of innovations (3.2), before a summarised framework will be presented (3.3) as a base for the subsequent discussions.

3.1 Technology as a social phenomenon

The oldest hominid technologies date back to around 2.6 million years ago and refer to the Oldowan assemblages in Eastern Africa, specifically Ethiopia and Kenya (*e.g.* Hovers 2012). Ever since, humans have relied on different technologies to pursue various activities and form social traditions, including hunting, fishing, gathering food, cooking, making clothes, storage, transport/mobility, rituals and much more. This has created a strong relationship between humans, technology and material culture. It is within this relationship that technology becomes a powerful proxy in order to understand the social aspects of prehistory, since it acts as a bridge between humans and the artefacts that they left behind.

Humans are not the only creatures that implement tool technologies. Many animals also transfer cultural traditions via social learning (cf. Hoppitt and Laland 2013). There are, however, many distinct differences between the ways humans and other primates transfer knowledge. The mechanics involved in the human transmission of knowledge differ even to our closest sister genus, the chimpanzee. For example, we have different social learning processes, unique types of cultural content (for example oral language and symbolic conventions) as well as distinctive population-level patterning, which have not yet been traced in chimpanzee populations or only to a significantly lower level (for details see Jordan 2015, 7-12).

Technology is also relevant as a social phenomenon. Dobres (2000, 96-97) argues that technology represents a socially constructed product that is created and maintained in the interactions and relationships between people, through social agency. Thus, it can be viewed as a highly dynamic web of interconnected social, cultural and material factors (*ibid.*, Dobres and Hoffman 1994). According to this perspective, the concept of technology is not centred on the artefacts or humans themselves, but rather on the space between them, which acts as a bridge between the two. Following this metaphor, the bridge also connects technology to other social phenomena, including, for instance, norms, ritualistic behaviours, economy and world views (Dobres and Hoffman 1994). The understanding of technology as a highly social construct allows studies of technology and material culture to become access points to approach social interaction, transmission of knowledge and traditions in past societies.

The social aspects of technology have been explored in a similar manner by Jordan (2015), who describes technology as a “human social tradition” (*ibid.*, 2). Jordan argues that technological traditions should be seen as material manifestations of the complex relationships between cultural information and the manner of which it is inherited, reproduced and transformed by actions of people and communities. The work by Jordan (2015) is rooted in the theory of cultural evolution and cultural transmission theory (cf. Cavalli-Sforza and Feldman 1981; Boyd and Richerson 1985; Shennan 2002; Creanza *et al.* 2017b). According to cultural transmission theory, cultural information (referred to as cultural traits) is propagated in a similar way as genetic traits (more on this in Chapter 3.2.3) However, a very important difference between the diffusion of cultural traits and genetic traits is the fact that cultural traits are passed on through social learning, *i.e.* by people's choices and actions, rather than randomness and evolutionary processes (Shennan 2002, 33-35; Jordan 2015, 18-19). Cultural transmission theory therefore supplies us with terms and concepts that can be used for a discussion of transmission of knowledge, but human agency remains in the centre of the approach. It is therefore a useful theoretical backdrop for an investigation of the transmission of a technology and its social mechanics.

Both Dobres (2000) and Jordan (2015) argue for viewing technology as a highly social construct, which can be accessed, for instance, through material culture. To approach the materials produced in this social setting, they both suggest the conceptual framework of *chaîne opératoire* (Dobres 2000, 51-68; Jordan 2015, 66-69).

3.1.1 *Chaîne opératoire*

The concept of *chaîne opératoire* has a long research history, starting already in the 1930s by Mauss (1935). It was, however, not until the 1960s that the concept was introduced to archaeology by Leroi-Gourhan (1993 [1964]). Since then, the concept has been continually explored and developed (*e.g.* Schiffer 1972; Lemonnier 1976; 1980; Pelegrin *et al.* 1988; Pelegrin 1990). The development of the concept since then has been summarised by Eriksen (2000, 75-100) and Delage (2017).

In summary, *chaîne opératoire* can be described as made up of two fundamental elements: knowledge (*connaissance*) and know-how (*savoir-faires*). Knowledge represents the information that is needed for an understanding of the steps required to reach an anticipated product. Know-how instead represents the information necessary to accomplish those steps (Pelegrin 1990, 117-18). These elements relate to different types of memory. *Declarative* memory (also: "knowing what" or explicit knowledge) and *procedural* memory (also: "knowing how" or implicit knowledge) (Squire 1986). While knowledge can be gained in various manners, know-how can only be gained through experience. This is because know-how relies on subconscious reasoning, in the form of motoric and intuitive actions, such as hitting the hammer stone with the correct amount of force based on its weight (Pelegrin 1990, 118).

For lithic technology, the *chaîne opératoire* directly relates the knapper's actions, choices and goals to the products created in the process. The steps taken in the process of tool making, from the gathering of raw materials to the production of blanks, reworking of blanks, artefact use and later discarding of artefacts, are all goal-oriented and aimed to reach a certain result. These steps together make up a "conceptual *schema opératoire*" which is understood by the knapper (Pelegrin 1990). During a *chaîne opératoire* analysis, these steps should be followed, not only to understand the process in which artefacts were made and used, but also to approach the dynamic social contexts in which they took place (Dobres 2000, 164).

Throughout the operational process, the knapper evaluates the situation and acts to conceptualise the schema, according to his/her experience, skill and wishes (Pelegrin 1990, 117-118). It is an understanding of those decisions and actions that are sought after in the analysis of the operational chain. The material remains, created in the various stages of the process, allow for these decisions to be observed and understood (cf. Eriksen 2000, 81).

3.2 Transmission of knowledge – in theory and practice

This part of the chapter will present the theoretical foundation that will be used to approach an understanding of the transmission of knowledge as it is implemented within this project. The theory is based on aspects of cultural transmission theory and an understanding of diffusion processes. The understanding of the diffusion of ideas is largely based on anthropological or ethnographic studies as well as studies of information flow in different social settings. Finally, these perspectives and ideas will be used to create a theoretical basis for the understanding of knowledge transfer and cultural change related to the handle core concept.

3.2.1 Innovation

The term *innovation* is used as according to Rogers (2003, 36), who describes innovations as "an idea, practice or object perceived as new by an individual or unit of adoption". In the context of this study, the handle core concept will therefore be understood as an innovation.

3.2.1.1 Why are things invented and how?

To approach the spread of the handle core concept, it becomes important to understand why and how knowledge and know-how spread in past societies. Rogers (2003) has focused on understanding the diffusion of innovations, mainly from the perspective of communication studies. However, the background to patterns of diffusion comes from a long research history that involved a large range of different disciplines such as sociology, social psychology, anthropology, education, communication studies, marketing and geography. The concepts and theories put forward by Rogers, thus, provide a strong foundation to understand and approach the diffusion of innovations and transmission of technologies.

Rogers (2003, 15-16) argues that five characteristics of an innovation, as viewed by individuals, affect the speed of which an invention is adopted, also known as the rate of adoption. The first one relates to its perceived *relative advantage* (1), compared to the previous state. The advantage can relate to either the innovation's functionality, design or efficiency or to the preference or subjective opinions of individuals or communities. This was also observed in the ethnographic studies by Jordan (2015, 351). Rogers (2003, 15-16) further argues that the more advantageous the innovation is perceived, the faster it will be adopted.

Another factor is *compatibility* (2), which involves the degree to which the innovation is compatible with existing norms, values and experiences of the individuals and communities in which the adoption occurs. If the innovation is compatible with already existing norms, it has a potential for a more rapid adoption compared to communities that have incompatible norms (Rogers 2003, 15-16).

The level of *complexity* (3) also affects the rate of adoption. If an innovation is considered complicated to use or understand, it is less likely to be adopted at all or it may be adopted over a longer period of time (Rogers 2003, 16). A similar idea has been proposed by Pelegrin (2012) who discusses complexity in relation to different modes of pressure technique. He argues that certain methods involved in blade production, using pressure technique, are too complex to be individually invented or copied. Instead, he argues, they require active teaching.

The term *complexity* has been used in many different ways (cf. Hoffecker and Hoffecker 2018). I will, however, use the term complexity as a description of the involved procedural units and types of knowledge involved in the *chaîne opératoire* related to a concept (similar to the definition by Perreault *et al.* 2013). Furthermore, the use of the term complexity can also refer to the use of multiple technologies that are related to the handle core concept, such as the making of slotted bone points, preparation of pitch, hunting, *etc.* Consequently, the more steps and/or levels of abstraction that are needed to reach the desired outcome, the higher the complexity of a technology.

Returning to the rate of adoption, Rogers (2003, 16) further argues that the possibility to try something out, referred to as *trialability* (4), before committing to a change has also proven to make for quicker adoption. When there is little chance for trialability, the rate of adoption is generally slower. Rogers (2003, 258) also argues that early adopters will perceive trialability as more important than later adopters.

For a lithic-based technology, the trialability is influenced by several factors, one of them being the availability of raw materials. If there are no or only few available raw material sources, one would expect that less experimentation would be possible and that raw materials should be prioritised for use with any necessary tools. In relation to this, a study by Andrefsky (1994) found that where there is an abundance of raw materials, both formal and informal tools are common, while a greater distance to raw material sources or more mobile communities tend to promote a focus on formal tools. Based on this study, it seems that a higher abundance of (knappable) raw materials can result in more technological experimentation. However, Manninen and Knutsson, K. (2014) investigated the relationship between raw material availability (flint) and the formalisation of tool-making. In this study, they showed that a shortage of raw materials does not necessarily lead to a formalisation of technologies. Rather, various adoptive strategies can be assumed, for instance, the addition of new lithic raw materials in one's repertoire (*ibid.*). This shows the need for more studies specifically focused on investigating selected communities and their strategies for dealing with a shortage of raw materials.

Finally, Rogers (2003, 16) also argues that *observability* (5) plays a role in the rate of adoption. This means that when the result of an innovation is visible to others, they are more likely to adopt the innovation, leading to a faster rate of adoption overall.

Innovations can also change as they are being diffused, which Rogers (2003, 17) refers to as re-invention. Such a re-invention can be more quickly adopted and diffused since it allows for more flexibility and can thus be fitted into the adopter's wishes. Jordan (2015, 344-345) showed, based on some ethnographic studies, that new traits were often introduced as adjustments or changes to already learnt technologies, rather than made up from scratch. Through this type of evaluation, the spread of a technology or trait could happen very rapidly across large areas (*ibid.*). Additionally, a higher degree of re-inventions also seems to result in a higher degree of sustainability (as in longer usage time) since inventions that are being repeatedly adjusted often become the most preferred version, commonly leading to a longer usage time for the final form of such an invention (cf.

Rogers 2003, 182-184). Furthermore, studies of modern diffusion processes have shown that re-inventions occur very often (especially in the initial implementation stage). Another pattern is that when an invention is introduced, it is often adopted in parts while older technologies/concepts continue to be used simultaneously (Rogers 2003, 182-183). Reasons for re-inventing a technology include, for instance, a too high level of complexity or a lack of knowledge regarding the technology in its initial introduction (leading to mistakes). Additionally, innovations that are a part of a more general concept that involves several areas of use are more likely to undergo re-invention (*ibid.*, 186-187).

Investigations of diffusion patterns have shown that most individuals evaluate an innovation based on the subjective evaluations by peers that have already adopted it, rather than on a basis of more objective analyses of the consequences. Diffusion is thus a highly social process that depends on interpersonal communication and relationships (*ibid.*, 18-19). Furthermore, communication is often more successful between people who have similar beliefs, education, social status, *etc.* (*ibid.*, 19-20).

Another important aspect of diffusion studies is time (Rogers 2003, 20-24). Time is involved in several parts of the diffusion process. Firstly, it is part of the *innovation-decision process,* which involves the time it takes for an individual to learn, consider, accept/reject and implement a new concept. Secondly, time is involved in the so-called *innovativeness,* which describes the relative earliness/lateness of individuals or groups to adopt an innovation (see below). Thirdly, time is involved in the *innovation rate of adoption*, which is measured in the number of individuals in a community that adopts the innovation within a certain time. Since this project focuses on a diffusion process in the past, from which not enough data is available for a highly resolute chronology, this temporal scale will need to play a smaller role in the understanding of the spread of the handle core concept, for now.

The concept of *innovativeness* describes the relative time it takes for people within a community to adopt an innovation. This pattern generally takes on a normal distribution (Fig. 19). The roles are then assigned to the different relative temporal stages of the curve, using the standard deviation and mean. According to this model, people will take on one of five roles: innovators, early adopters, early majority, late majority and laggards/late adopters (*ibid.*). The distribution curve shows a slow increase at first, with only a small portion of the population accepting the innovation in the initial stage (the early adopters). The curve then shows a sudden increase in adopters until half of the population has adopted the innovation (the early majority). After this, the curve distribution increases with a gradually slower rate until most people have already adopted the innovation (the late majority). Lastly, the amount of people adopting the innovation decreases before finally there are no new adopters (the laggards/late adopters).

To approach a full understanding of a diffusion process or transmission of knowledge in and between groups, it is important to understand that everything takes place within a social setting. In any society, there will be established norms, traditions and structures that hold the communities/societies together. For prehistoric societies, these norms will be very difficult, if not impossible, to approach due to their complexities and a lack of physical remains (*ibid.*, 2003, 23-25). However, as argued by, for example, Shennan (2002, 48-51) and Jordan (2015, 24-25), some aspects of the social setting can be indicated by the manner of knowledge transfer and the directionalities involved in the process (more on this in Chapter 3.2.4).

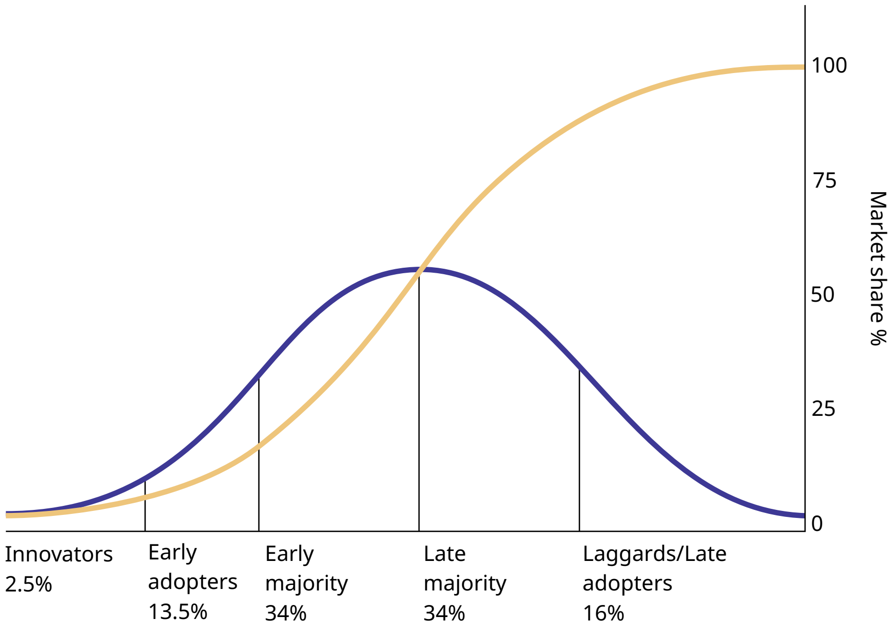


Figure 19. The general process of adoption of innovations. The blue (bell-shaped) curve shows the percentage of new adopters in the population over time. The yellow (s-shaped) curve represents the cumulative rate of adoption (after Rogers 2003, 281. Graph from Public domain, via Wikimedia Commons).

3.2.1.2 Drivers of innovation in culture

Many studies have indicated that the frequency of cultural innovations and the related cultural variation are dependent on demography and access to external networks or migration (Henrich 2007; Creanza *et al.* 2017a; Apel *et al.* 2018; Berg-Hansen 2018; Damlien *et al.* 2018). Furthermore, when innovations lead to more productive subsistence strategies, they have the potential to result in population increases, which in turn amplifies the drivers (Creanza *et al.* 2017a). A reason for these relationships between innovation and population density has been suggested by Henrich (2004). He argues that communities with high demography and/or access to large external networks have access to an extensive pool of cultural variants that can be mixed and matched to form new innovations (*ibid.*).

The relationship between the mechanics of transmission of knowledge and demography has been investigated archaeologically in a study by Berg-Hansen (2017; 2018), who focused on core reduction strategies during the Late Palaeolithic/Early Mesolithic in different parts of Northern Europe. The results showed highly standardised blade production methods within the Palaeolithic Ahrensburgian technocomplex, indicating mobile and well-connected societies with extensive social networks that included regular contact within the area. In the Early Mesolithic assemblages, there is instead more variation and flexibility in blade production methods, which could indicate less regular contact between societies, perhaps due to a difference in mobility patterns. This pattern was suggested to be a result of increased regionalisation (*ibid.*). The same pattern of regionalisation has also been observed for the end of the Early Mesolithic in Western Scandinavia, based on technological differences related to smooth/faceted core platforms (Damlien *et al.* 2018). A similar pattern is also seen for Southern Scandinavia at the same time (Sørensen 2018). These works are good examples of archaeological research, which showed that technological variation over time can be understood from the perspective of diffusion studies, directionality of knowledge transmission and social organisation.

It is often argued, based on archaeological and anthropological evidence, that even though the spread of cultural information has the potential of being much faster than genetic propagation, cultural transmission is instead slowed down by social traditions. It has been suggested that strong social solidarity, based on shared experiences and values, slows horizontal transmission in human societies (Frieman 2012; Apel *et al.* 2018, with sources). Although many lithic traditions were used over generations, there might be more variation within these concepts (temporally or spatially) than what we can make out with our current knowledge base, especially since we are constantly working with fragmented assemblages in which small-scale variation may be difficult to identify.

3.2.2 The mechanics of cultural transmission and genetic propagation

According to cultural transmission theory, transmission of knowledge can be understood in relation to genetic propagation (Cavalli-Sforza and Feldman 1981). The parallels between these allow for an approach to a transmission of knowledge via an established framework and terminology that leads to new ideas and perspectives to explain processes or cultural change in prehistoric settings (Shennan 2002, 33-35; Jordan 2015, 18-19, 21-23). The features of cultural and genetic propagation are compared in Table 2, and the differences between them are discussed below.

Feature 1 describes how information is transferred. In cultural propagation, it is transmitted between people through social learning (more on this below). Genetic propagation, however, solely involves a vertical transmission from parents to offspring via sexual reproduction. Cultural traits are thus learnt, as opposed to genetic traits which are inherited (Cavalli-Sforza and Feldman 1981; Shennan 2002, 33-35; Jordan 2015, 18-22).

Feature 2 describes change on an involuntary level. Within cultural transmission, mistakes or errors in the production process result in changes, adjustments or new innovations. This can happen for many reasons, for instance, when the knowledge is not (yet) fully transferred or if more practice is needed to be able to carry out the practical know-how. Within genetic propagation, random change is instead introduced through mutation (Jordan 2015, 18-22).

Feature 3 describes change on a voluntary level. Within cultural transmission, this happens due to the active choice of an individual or within a community. Within genetic propagation, this instead occurs in an evolutionary manner, through the survival of more beneficial or preferred traits (Jordan 2015, 18-22).

Feature 4 describes the reasons for variety within and between populations. For cultural transmission, this is sometimes referred to as cultural drift. Cultural drift has been observed as typological or technological variations within technological concepts in different regions. Drift also occurs naturally within genetic propagation (Jordan 2015, 18-22).

Anthropological studies have shown that local or regional differences in material culture often relate to ethnolinguistic patterns and social networks (Hodder 1982).

Feature	Cultural propagation	Genetic propagation
1	Information is passed on between individuals through social learning.	Information is inherited via sexual reproduction, transmission.
2	Change is introduced to the system through simple errors.	Change is introduced via mutations and leads to variation and evolution through a random process.
3	Change is introduced to the system through active choices by people.	Genetic information changes, which is based on which characteristics are considered favourable over others for evolutionary/survival/reproduction purposes/selection.
4	Small-scale anomalies within populations lead to the appearance/disappearance of cultural traits.	Random changes occur in the frequencies of genetic traits, drift.

Table 2. Differences between cultural and genetic propagation (after Jordan 2015, 18-19 and Shennan 2002, 33-35).

Differences in cultural traits are thus assumed to indicate a lack of communication/contact, a conscious decision to be different or as a way of indicating group identity. However, differences in material culture can also relate to non-social (or semi-social) factors such as environmental stressors or resource availability. Related to this is the theory of *convergent evolution* (cf. Groucutt 2020), which assumes that given similar environmental conditions, similar social structures will develop independently in different societies around the world. Evidence of adaptation to the local climate or landscape can be found in some anthropological sources (*ibid.*; Hodder 1982), but other studies have highlighted the importance of cultural factors over environmental ones (*e.g.* Groß *et al.* 2018). Thus, external factors should be seen in relation to the social factors that lead to the appropriate adaptation strategy.

3.2.3 Directionality

Factors that affect the transmission of knowledge include the social setting in which it takes place and the directionality of the knowledge transfer. Directionality refers to who is teaching whom. The teaching involved in these scenarios includes both active and non-active teaching (see below). Four general directions are often described; *vertical*, *horizontal*, *one-to-many* and *many-to-one* (Table 3). The different directionalities relate to specific trends regarding the acceptance of innovation, variation between individuals within a population, variation between groups and rates of cultural evolution (Shennan 2002, 48-51; Jordan 2015, 25). However, these patterns should be seen as simplified predictions based on theoretical scenarios and not as a blueprint for understanding transmission of knowledge in all social settings. They, nonetheless, provide a good baseline for discussions of the mechanics involved in transmission of knowledge (Jordan 2015, 25).

Vertical transmission occurs when knowledge is transferred from parent to offspring. Within cultural transmission, this is one of several ways that information can be propagated (Shennan 2002, 48-49; Jordan 2015, 24). Another directionality involves oblique knowledge transfer, which involves any member of the older generation teaching a member of a younger generation (cf. Creanza *et al.* 2017b). According to this theoretical model, both vertical and oblique directionalities tend to lead to innovations being accepted with intermediate difficulty, making it a slower form of knowledge transmission that takes place over several years compared to horizontal transmission, which is more likely to take place over a shorter time frame. It also tends to result in highly varied knowledge sets amongst individuals in a group (Shennan 2002, 49-50; Jordan 2015, 24), although, this must also depend

	Vertical/Oblique	Horizontal (or contagious)	One-to-Many	Many-to-One (or concerted)
Transmitter	Parent(s)/Older ind.	Unrelated	Teacher/leader/media	Older members of a social group
Transmittee	Child/Younger ind.	Unrelated	Pupils/citizens/audience	Younger members of social groups
Acceptance of innovation	Intermediate difficulty	Easy	Easy	Very difficult
Variation between individuals within a population	High	Can be high	Low	Lowest
Variation between groups	High	Can be high	Can be high	Probably smallest
Rates of cultural evolution	Slow	Can be rapid	Most rapid	Most conservative

Table 3. Different modes of cultural transmission and impacts on cultural uniformity and change (after Shennan 2002, 50; Jordan 2015, 25).

on the level of heterogeneity within the community. Vertical/oblique transmission of knowledge also leads to a lot of variety between different groups as well as a slow rate of cultural change (Shennan 2002, 49-50; Jordan 2015, 24).

Horizontal transmission occurs when knowledge is transferred within a generation, between unrelated peers. In this case, innovations are often more easily accepted and this is therefore a more liberal form of knowledge transmission compared to vertical transmission. Knowledge between individuals in a group, and variation between groups, is diverse and rates of cultural evolution can be rapid (Shennan 2002, 49-50; Jordan 2015, 25). In theory, this means that innovations can spread faster through a horizontal transmission of knowledge compared to vertical.

When knowledge is transferred from *one-to-many*, one person (often with a higher authority/status) teaches several people (with lower authority/status). This hierarchical directionality leads to innovations being rather easily accepted (Shennan 2002, 49-50), although this assumes that the teacher is the innovator, which is not necessarily the case. Shennan (*ibid.*) also mentions that variation between individuals in a group is low (since they are all taught the same thing), but variation can be high between groups instead. The rate of cultural evolution is considered most rapid, since any innovation/change can be quickly spread from one person (teaching) to many people (learning) and possibly onwards from there.

When knowledge is transferred from *many-to-one*, several people (with a higher authority/status) teach one person (with a lower authority/status). In this case, the acceptance of innovations is assumed to be very difficult (Shennan 2002, 49-50). However, this also depends on the level of innovation from the teachers' side and would assume that the teachers are a homogenous group with the same perspectives. Shennan (*ibid.*) further argues that variation between individuals in a group and between groups is the lowest of all directionalities. The rate of cultural evolution is assumed to be the most conservative. What is not considered here, however, is the level of conservatism among the teachers. Highly innovative teachers would rather generate a more rapid rate of evolution.

The directionalities mentioned here do not include all ways in which knowledge can be transferred. On the contrary, ethnographic research has shown that cultural transmission is highly varied within and between societies and that learning occurs in many ways, often simultaneously (Jordan 2015; Lew-Levy *et al.* 2017). Nonetheless, the directions included in Table 3 are useful as a starting point for approaching the role of teachers and learners and their effects on the acceptance of innovation, cultural variation and the rate of cultural change.

A study by Jordan (2015) found a large variety in how knowledge is transferred among hunter-gatherer societies. By comparing information from various communities in Northern Eurasia and North America, he found that knowledge relating to different technologies was transferred in various ways, each with its own own sets of characteristics and mechanics (*ibid.*, 362). Furthermore, the character of knowledge transfer, including directionality, changed throughout a person's life. Two main stages of cultural transmission were found. *The first stage* took place during childhood and adolescence and was generally characterised by vertical transmission of knowledge, as parents or other older individuals would teach younger individuals. In this phase, individuals learn basic skills through active teaching/learning in the form of demonstration, observation, scaffolding *etc. The second stage* took place over the span of a person's adult life, after adolescence. In this phase, knowledge was propagated through horizontal transmission, between adult practitioners, often from a much wider network consisting of distant relatives, friends, acquaintances, *etc.* Knowledge transfer was done through observations, demonstration and experimentation.

Several stages of learning are described in the meta-ethnographic study by Lew-Levy *et al.* (2017). The study focuses on the process of learning subsistence skills in modern hunter-gatherer groups and 58 ethnographic publications were included in the results. They found that learning generally starts already during infancy as small children are brought along to carry out subsistence tasks. The children are often included in the process, via their parents, by being given small versions of tools to perform very simple tasks. As children enter early childhood, they learn most of their subsistence skills through mechanisms such as participation in a task, play and observation. They are taught by adults, but in interaction with other children. More complex tasks, including hunting, making complex tools or learning innovative behaviours, are instead taught during late childhood/adolescence. These tasks are generally taught obliquely by experts, but parents still play an important role as well. Furthermore, it was concluded that many hunting practices were taught continuously throughout adult life (*ibid.*).

3.2.4 Active and non-active teaching

The involvement of the teacher during learning also plays a large role in how and which type of knowledge is transferred. A teacher/learner can partake in two general forms of teaching:

Non-active teaching, or copying, is a form of teaching that involves giving little or no feedback. The pupil simply observes the teacher and then copies. This is generally done via *emulation* or *imitation*. Emulation involves a goal-oriented copying and is generally aimed to reproduce an observed end-result, a finished tool for example. Imitation is also known as process-oriented copying and is aimed to reproduce the actions that lead to the end-result (Jordan 2015, 9). Non-active teaching has often been highlighted as an important part of the initial learning process, often done via play, during childhood (Kamp 2001; Högberg 2008; Sternke and Sørensen 2009; Högberg 2018; Högberg and Gärdenfors 2015; Lew-Levy *et al.* 2017).

This type of "silent" teaching, without explaining or providing directions, has also been observed in several anthropological studies, for example, within certain communities of hunter-fisher-herders in Eastern Siberia. Here, practical skills were demonstrated rather than explained, while more abstract skills were explained along with a demonstration of the more practical aspects of them (Grøn *et al.* 2009). Demonstration can, however, be seen as an active or non-active form of teaching depending on how it is done. Among the Australian Aborigines, hunting, gathering and other practical skills are taught informally by participation in the activities and observation (Holdaway and Allen 2012). In an ethnographic study of language learning among two small Inuit communities in Quebec by Crago (1992), one finding showed that a lot of the language learning among young children occurred during bed time as the children were supposed to be sleeping but were instead eavesdropping on their parent's conversations. Furthermore, hunting was found to be an activity that was solely learnt through observation of the adults (Crago 1992).

Active teaching, instead, involves active interaction between the teacher and the pupil. This can be done though *helping and correcting*, *showing* or *explaining*. Helping and correcting is done via feedback from the teacher in the form of scaffolding or by approval/disapproval. Showing involves the teacher drawing attention to, or demonstrating, something. Finally, explaining involves oral communication aimed to explain a concept (Högberg *et al.* 2015; Gärdenfors and Högberg 2017). This form of teaching is often discussed in relation to "apprenticeship" during adolescence and adulthood (Jordan 2015, 344; Lew-Levy *et al.* 2017), however, it is likely to have been important already during childhood (*ibid.*; Tehrani and Riede 2008).

3.2.5 Apprenticeship and communities of practice

The idea of apprenticeship is often considered a specific type of teaching, generally through a formal (although sometimes informal) relationship between a teacher and a learner, between individuals or within groups (cf. Wendrich 2012). Apprenticeship involves transmission of knowledge by both observation and direct experience (Miller 2012). The aim of an apprenticeship is to learn a skill, dexterity, endurance, memory, considerations and/or properness together with knowledge, know-how, inspiration and motivation (Wendrich 2012, 2-3).

Anthropological studies on transmission of knowledge in hunter-gatherer groups have often been centred on the concept of apprenticeship (cf. Wendrich 2012). In these studies, learning is described as a very formal apprenticeship where a skill is taught over long periods of time, sometimes years, and structured in subsequent phases with exceeding amounts of responsibility (Apel 2001; Stout 2002, 207; Høgseth 2012; Milne 2012; Wendrich 2012). In contrast, other studies describe a less formal manner of apprenticeship, where individuals instead take part in different activities where they, mainly by means of participation, learn a trait or skill (Wenger 1998; Cooney 2012; Holdaway and Allen 2012; Rockman 2012; Rogoff 2014).

In this thesis, I will use the term apprenticeship for the more structured manner of learning, where someone (an apprentice) participates in some form of learning (active and/or non-active) with an aim to learn a skill or series of skills over time from another person or group (teacher/teachers). I therefore assume that the aim of the apprenticeship is its most important characteristics, *i.e.* the purpose to learn a specific trait/skill/activity from someone else. For situations that are characterised by a more general learning atmosphere, *e.g.* a group setting with participation-based learning, I do not find the term apprenticeship useful, as such a setting does not integrate the structured manner of learning with a specific, pre-defined skill (set) as an aim.

Apprenticeship is often held as a general model for knowledge transfer, although there are many other ways of teaching and learning, as I have highlighted in this chapter. Although apprenticeship is likely to be a common form of teaching/learning, it may be overrepresented in ethnographic research since it is easily spotted, while other forms of teaching and learning are carried out in less obvious ways. Furthermore, the term apprenticeship seems to incorporate a large variety of teacher-apprentice relationships, both formal and informal ones, which clearly allow for a very broad implementation of the concept.

Anthropological studies have shown that informal ways of learning play important roles in our societies, both historically and today (Wenger 1998; Cooney 2012; Holdaway and Allen 2012; Rockman 2012; Rogoff 2014). Some examples of informal, observation- and participation-based learning take place in all societies and relate, for instance, to social norms, behaviours, emotions, language (although this is also formally learned) and music (Rogoff 2014). Wenger (1998, 11) has developed the concept of apprenticeship from focusing on a one-to-one, master-and-apprentice-style relationship to instead include multiple social dynamic relationships as a foundation of the learning process. The importance, thus, lies in participation and inclusion within various social groups, or *communities of practice* (*ibid.*).

The concept of *communities of practice* assumes that the transmission of knowledge occurs through active participation and engagement in society. Wenger (1998) argues that active participation in society also results in the development of various fundamental processes which involve manifestations in a variety of simultaneously occurring societal spheres, such as *meaning*, *practice*, *community* and *identity* (*ibid.*, 3-9). *Meaning* is created when people learn from others in a community. As individuals learn and gather competence about a certain skill or activity over time, a sense of purpose is created (*ibid.*, 51-71). *Practice* makes up the active participation in the community. *Community* is the shared social arena where all of this takes place. Individuals most often participate in various communities simultaneously. For example, one person might be a part of the knapping community, the hunting community and the adolescence community (*ibid.*, 72-85). Finally, *identity* is created as people learn and participate in the different communities. Social roles are created in the process and identities are built (*ibid.*, 145-221).

The active participation and engagement in *communities of practice* represent not only an integral part of learning skills and acquiring knowledge, but they also allow for the creation of identity, meaning and a sense of social belonging (Wenger 1998). This theory presents an idea of how humans *are* in general, not only in history, but I find that these ideas also set a logical backdrop for an understanding of prehistoric humans.

3.3 The theoretical framework for this study

The theoretical framework outlined in this chapter will be summarised here to provide a series of general assumptions that will be used (in Chapter 7) to approach aspects connected to the transmission of knowledge related to the handle core concept in Northern Europe during the Mesolithic. These assumptions are as follows:

- New technologies are more likely to be invented and adopted (more rapidly) if they have a relative advantage to current technologies or if they are easily compatible with already established technologies.
- New technologies are more rapidly adopted when they can be tested/tried prior to adoption or if a new technology can be observed and its results understood before adoption.
- The complexity of new technologies affects the speed of adoption. The more complex they are to understand, the less likely they are to be adopted and/or the process of adoption is generally slower.
- Re-invention of a technology is more likely to result in a rapid diffusion and to be sustained longer.
- Diffusion of innovations or the *transmission of knowledge* make up highly social processes in which the social organisation, the individual, norms, traditions and economy affect the mechanics of knowledge transfer.
- External factors relating to changes in resources, environment, climate, or others, can play a role for societies that are affected by the changes. But external factors do not have to trigger changes in societies.
- Innovation is more likely to occur in a larger population and/or when groups of people are in strong contact with other groups of people, *i.e.*, when social interaction is regular/common.
- Vertical and oblique forms of transmission of knowledge often involve slower rates of innovation and more cultural uniformity, due to a stronger sense of tradition/social pressure.
- Horizontal forms of transmission of knowledge often lead to faster rates of innovation and more cultural variety, due to a lesser sense of tradition/social pressure.
- The role of the individual, as a teacher (active or non-active) and the learner, affects the characteristics of knowledge transfer, and thus the material culture.

These general assumptions will be used to approach the transmission of knowledge related to the handle core concept. By identifying factors relating to these assumptions in the technology of the handle core concept, in different parts of the research area, I can approach aspects of, for instance, interactions, social roles, mechanics involved in teaching and learning as well as directionalities of knowledge transfer. However, transmission of knowledge is highly varied within and between societies, at any time and over longer periods of time (cf. Lew-Levi *et al.* 2017). Therefore, the goal of this thesis is not to find the "one way" that knowledge was transferred in the Mesolithic, since such a one-fits-all solution is unlikely to have existed. Rather, I aim to understand the mechanics involved in the transmission of knowledge relating to one specific technology, the handle core concept, during its implementation within Mesolithic societies in Northern Europe.

4 Methods

To approach the mechanics involved in transmission of technological knowledge and know-how during the Mesolithic, I focus on the diffusion of the handle core concept (HCC). The concept is investigated by means of technological analysis, concentrating on the handle cores and the blades produced from them. The details of the technological analysis will be described in Chapter 4.1. The technological analyses will provide a baseline for comparisons of the concept in different parts of Northern Europe, and will be used as a base to understand technological variation across the research area. The data collected through this process will also undergo statistical testing as well as univariate and multivariate analyses (4.2) to highlight which attributes play a larger role in the implementation of the concept in the different focus areas. Via these methods, it is possible to approach patterns of communication and diffusion across the research area. Additionally, the methods for collecting and evaluating available radiocarbon dates and related sample materials will be described, along with the methods used for collecting and dating a small number of new samples (4.3).

4.1 The technological analysis

The technological analysis follows a process described by Pelegrin (1990). It involves the mapping of available finds from a site or context, including the identification of raw materials, techniques and methods used for knapping. Based on the technological attributes, here collected in a recording scheme for reasons of comparability, the operational stages can then be approached through a form of “mental reassembly” of the materials. Through this process, the finds are understood a being a part of a *chaîne opératoire* (*ibid.*).

4.1.1 The analysis process

The technological analysis involved the recording of technological attributes on the finds (handle cores and related blades), which represent traces from their production, use and maintenance. The relevance of the attributes and attribute morphologies have been observed and recorded, extensively, through experimental knapping and archaeological material studies (*e.g.* Knutsson 1980; Callahan 1985; Pelegrin 2000; Sørensen 2006; Desrosiers 2012; Damlien 2015).

The first step of the recording process involves selecting the cores and blades that are relevant for the concept in question. This is important in order to create a representative and reliable dataset for the analyses and, subsequently, to enable reliable results. Therefore, some definitions were set up at the beginning of the data collection process to ensure that the recorded data is 1) related to the handle core concept and 2) not affected by any biases of what the concept “is” or “should be”. The definitions used for recording data were therefore necessary to ensure that data was recorded in a transparent and reproducible manner. Nonetheless, to ensure that any regional variation could be identified, certain definitions were kept broad. The following guidelines are therefore based on a middle ground between previously established definitions of handle cores (from Scandinavia) and known features of pressure technique, but with some technological wiggle-room for regional technological variations.

4.1.1.1 Guidelines for the recording of handle cores

The elongated shape of the core and the placement of the front on one narrow end (or possibly two opposing ends) has been suggested to be a distinct feature of the concept, based on previous research from Scandinavia. It seems to be an important technological feature that allows many blades of a similar size to be produced from one core (Knutsson 1980; Larsson 1978; 1983). However, it should be noted that the elongated shape of the core is highly dynamic, since each core starts out at a different size. Additionally, the length of the core is reduced throughout the blade production process. Some have even argued that an exhausted handle core will take the form of a sub-conical core (Knutsson 1980; Ballin 1999; Eigeland 2015; Reitan 2016).

Additionally, the concept is defined via its implementation of pressure technique (Larsson 1978; Callahan 1985; Knutsson 1993; Sørensen 2001; 2006). Therefore, the presence of regular blade negatives on the core front is another feature that defines the core type. Even though these aspects will be explored in more detail within the project, they are used as a starting point for the material studies. To summarise, cores will be recorded according to the following characteristics (Fig. 20):

- Elongated core with a blade production front limited to one narrow (or two opposing) ends
- Negatives on the core front indicate a regular blade production.

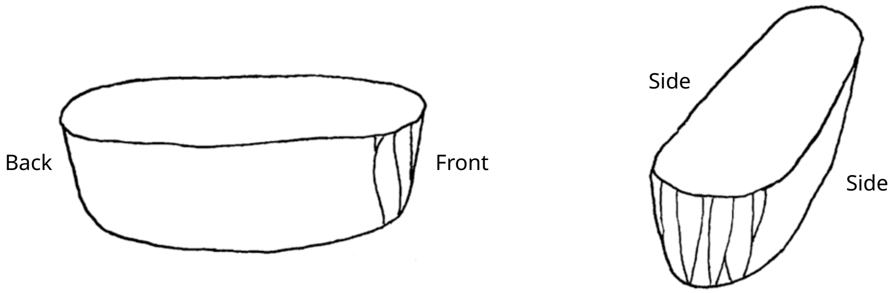


Figure 20. Schematic drawing of a handle core. Showcasing parts: front, back and lateral sides (Illustration: S. Söderlind).

4.1.1.2 Guidelines for the recording of the relevant blades

By using the ratio between length and width, blades can be separated from flakes, as flakes tend to be wider rather than longer. This is not true for all flakes, however, and in an effort to remove any "accidental blades", *i.e.*, flakes that happen to become twice as long as they are wide, the second requirement was added. By defining a blade as being a part of a serial production sequence, we assume that the knapper was working in a goal-oriented manner with the aim of producing long, narrow and somewhat regular blanks, with parallel sides and dorsal ridges.

Thus, a blade is defined as an artefact that:

- has a length:width ratio of 2:1 or more
- shows signs of being produced within a serial production.

Blades from handle cores additionally follow some attributes that relate to the definition of the handle core and the technological choices behind the concept. As already mentioned, the handle core definition is partly based on the attribute that the blades, produced from them, are produced by means of pressure technique. The blades produced from a handle core should therefore have attributes that support the implementation of such a technique. Blades from handle cores are often described as having regular blade sides and dorsal ridges, slightly curved/straight profiles, a thin/slender form and small platforms (Sørensen 2001; Pelegrin 2012). Additionally, blade regularity, a lack of conus formation and a platform angle of ca. 90 degrees have been especially confirmed as common features of pressure technique (although these attributes can also appear in low amounts in assemblages of blades produced using indirect technique; cf. Damlien 2015). These signs of pressure technique are added to the general blade definition above. A blade is thus defined as an artefact that

- has a length:width ratio of 2:1 or more
- is produced in a serial production
- shows signs of being produced using pressure technique.

These attributes however, are not exclusive to handle cores but rather are found on all blades produced using pressure technique. Thus, handle core blades are here not really separated from other technological concepts that implement these techniques. Rather, the selection of sites and assemblages characterised by the presence of handle cores will reduce the chances of recording blades related to other pressure concepts.

4.1.2 The recording scheme

A recording scheme was used to document the technological attributes related to the handle core concept. Many of the attributes and attribute morphologies included in the current recording come from a recording system (version 1.21) established at the *Centre for Baltic and Scandinavian Archaeology* (ZBSA), in Schleswig, Germany (henceforth referred to as *ZBSA scheme 1.21*). Some of these attributes were adjusted to better fit the research questions, according to the descriptions of the individual attributes below. Additionally, some attributes were added from the dynamic classification scheme established by Sørensen (2001; 2006) and further developed by the international research network *Nordic Blade Technology Network* (NBTN) (and summarised by Sørensen 2013). The resulting recording scheme can be found in Appendix I, and will be described below. The acronyms for the various attributes often refer to German terms. The scheme is structured in three different sections (according to ZBSA scheme 1.21):

- *General information* (Chapter 4.1.2.1). This section includes information regarding both cores and blades. Each find is recorded in this section.
- *Core information* (Chapter 4.1.2.2). This section only includes information regarding the cores and core fragments (including rejuvenation flakes).
- *Blade information* (Chapter 4.1.2.3). This section only includes information regarding blades and blade fragments.

4.1.2.1 General information

Raw material (RAW)

The raw material of each find was distinguished optically. Variations of different raw materials, for instance, various types of flint, were not recorded. Raw materials were listed numerically as they were encountered (see Table 4).

No.	Meaning
1	flint
2	quartzite
3	jasper
4	chert

Table 4. Raw materials (RAW) and attribute variations.

Cortex/natural areas (ACN)

The amount of remaining cortex on cores has implications for the core preparation process and the initial shape and size of the nodule. The amount of remaining cortex on blades indicates the stage in which the blade was produced (after ZBSA scheme 1.21., with adjustments and some attribute variations removed; Table 5).

No.	Meaning
0	no remaining cortex
1	≤ ¼ of cover
2	¼ < cover > ¾
3	≥ ¾ of cover

Table 5. Cortex (ACN) and attribute variations.

Basic form (GF)

The basic form lists which type of blank/debitage was used (after ZBSA scheme 1.21., with some attribute variations removed; Table 6).

No.	Meaning
1	flake
2	blade
3	core

Table 6. Basic form (GF) and attribute variations.

Type of artefact (ARTA)

This attribute specifies the type of flake, blade or core that was recorded based on characteristics such as presence/absence of retouch, presence/absence of blade negatives and area of rejuvenation (after ZBSA scheme 1.21., with some attribute variations removed, and variations 950, 951 and 952 added; Table 7; Fig. 21).

No.	Meaning
050	blade
051	blade with retouch
855	handle core
858	handle core preform
950	rejuvenation flake – front
951	rejuvenation flake – platform
952	rejuvenation flake – side/front

Table 7. Artefact types (ARTA) recorded within the project.

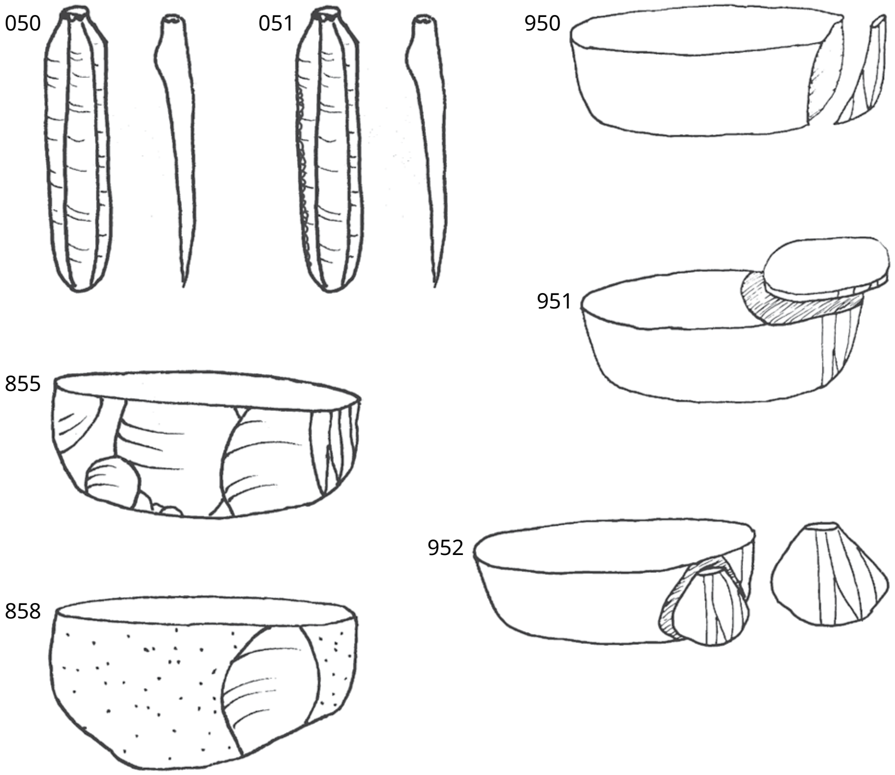


Figure 21. Artefact types (ARTA) recorded within the project (Illustration: S. Söderlind).

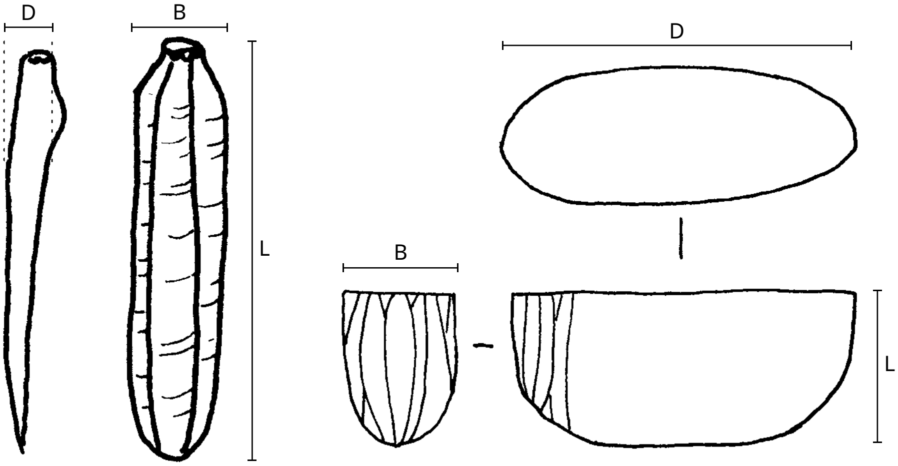


Figure 22. How length (L), width (B) and thickness (D) were recorded on blades and cores (Illustration: S. Söderlind).

Length (L), width (B) and thickness (D)

The measurements were recorded in millimetres (mm), as indicated in figure 22. Blade length (L) was measured at the longest point between proximal and lateral ends. Width (B) was measured at the widest point between the lateral sides. Thickness (D) was measured at the thickest point between ventral and dorsal sides, below the bulb of percussion.

Core length (L) was measured at the longest point between platform and keel. Width (B) was measured at the widest point between the two lateral core sides. Thickness (D) was measured at the longest point between the core front and back.

Figure 23. Platform design (KSFA) and attribute variations (Illustration: S. Söderlind).

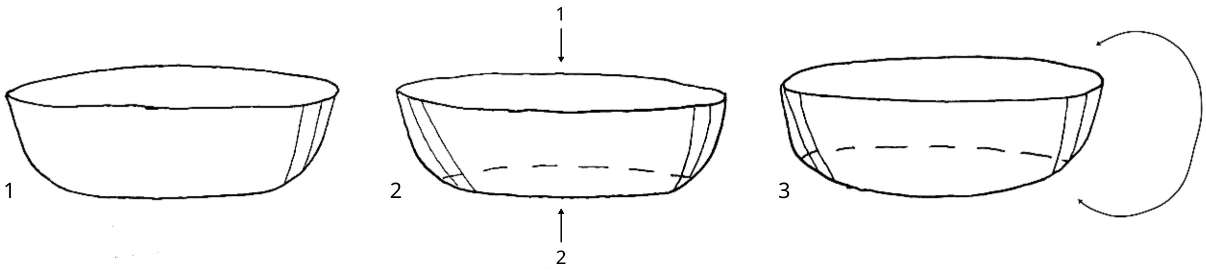


Figure 24. Platform use (KSFN) and attribute variations (Illustration: S. Söderlind).

4.1.2.2 Core information

Platform design (KSFA)

Platform design is recorded to further understand the system for the preparation and shaping of the core. Each platform is recorded independently (after ZBSA scheme 1.21., with some attribute variations removed; Table 8; Fig. 23).

No.	Meaning
1	one platform
2	two platforms – opposing
5	two or more platforms otherwise arranged

Table 8. Platform design (KSFA) and attribute variations.

Platform use (KSFN)

Platform use is relevant in order to understand how the core was implemented during blade production. Additionally, it provides information regarding the preparation of the core (after ZBSA scheme 1.21; Table 9; Fig. 24).

No.	Meaning
1	one main platform
2	two platforms – used in succession
3	two platforms – used alternating

Table 9. Platform use (KSFN) and attribute variations.

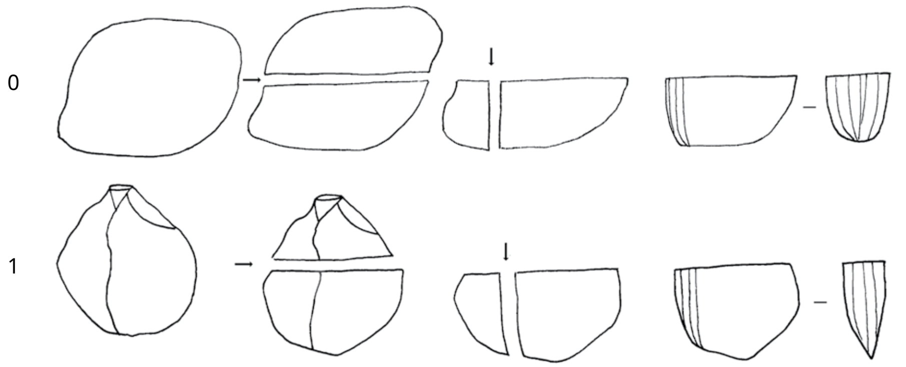


Figure 25. Handle core on flake (HCF) and attribute variations (Illustration: S. Söderlind).

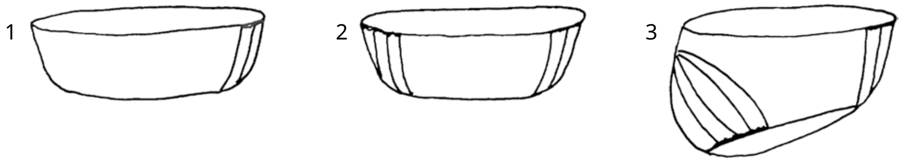


Figure 26. Core front design (KAAN) and attribute variations (Illustration: S. Söderlind).

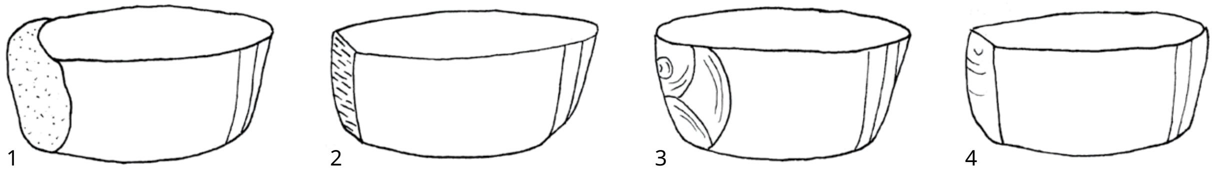


Figure 27. Core back (KR) and attribute variations (Illustration: S. Söderlind).

Handle core on flake (HCF)

This attribute records which type of blank was used as a base for the core. This is relevant to understand the initial stages of core preparation and use (after observations by Sjöström (2004) and Frandsen (2015); Table 10; Fig. 25).

No.	Meaning
0	not made on flake
1	made on flake

Table 10. Handle core on flake (HCF) and attribute variations.

Core front design (KAAN)

The design of the core front relates to the preparation and use of the core (after ZBSA scheme 1.21., with changes to attribute variation 3; Table 11; Fig. 26).

No.	Meaning
1	one core front
2	two core fronts – placed independently
3	two core fronts – placed on opposite ends of platform

Table 11. Core front design (KAAN) and attribute variations.

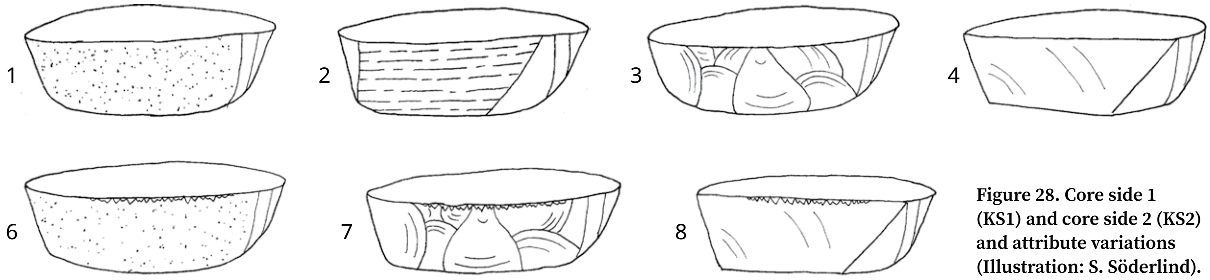


Figure 28. Core side 1 (KS1) and core side 2 (KS2) and attribute variations (Illustration: S. Söderlind).

Core back (KR)

The core back is located opposite from the front side of the core. The attribute relates to the core preparation process (after ZBSA scheme 1.21., with some attribute variations removed; Table 12; Fig. 27).

No.	Meaning
1	cortex cover
2	frost break
3	preparation (flake) negatives
4	one dorsal/ventral surface

Table 12. Core back (KR) and attribute variations.

Core side 1 (KS1) and core side 2 (KS2)

The lateral sides of the core are recorded as core side 1 and 2 (for orientation, see Fig. 28). These attributes provide an idea about the preparation of the core. Additionally, attributes on the core sides may relate to the manner in which the core has been held. Previous studies have indicated retouch on the edge between platform and core sides (henceforth referred to as "lateral edge preparation") and are remnants from the core being fixed in a holding device (Andersen 1984; Sørensen 2001; 2003; 2006). Callahan (1985) has, however, argued that the attachment of the core in a holding device was made much easier by making the lateral core sides parallel but that the lateral edge preparation was not necessary. Abrasion on the lateral edges was instead needed if the core was to be held in the hand (to avoid any cuts). Additionally, he argued that hand-held cores did not need to have fully parallel sides since the hand could manage some core irregularity (*ibid.*). Although Callahan's results indicate that the remains could reflect both holding in a device or holding in the hand, use wear studies (Sørensen 2001; 2006) have indicated that the cores had been pressed from the sides, which support the theory that the traces of the sides of the cores reflect this activity. The findings of similar traces on the underside of the core were interpreted as an indicator that the core was also supported from underneath during blade production (Sørensen 2001; Appendix I).

This recording system does not consider the character of the lateral edge preparation (abrasion or trimming). Instead, the presence/absence of lateral edge preparation in addition to other types of side preparation are recorded (after ZBSA scheme 1.21., with some attribute variations removed, and variations 6, 7 and 8 added; Table 13; Fig. 28).

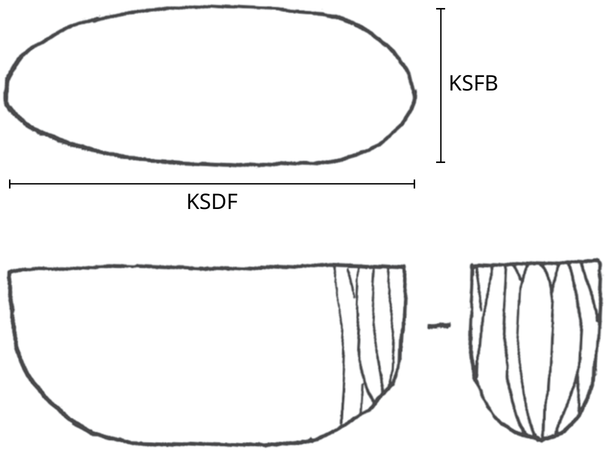


Figure 29. How platform width (KSFB) and platform thickness (KSFD) were recorded (Illustration: S. Söderlind).

No.	Meaning
1	cortex cover
2	frost break
3	preparation (flake) negatives
4	one dorsal/ventral surface
6	cortex (1) + lateral edge preparation
7	preparation (flake) negatives (3) + lateral edge preparation
8	one dorsal/ventral surface (4) + lateral edge preparation

Table 13. Core side 1 (KS1) and core side 2 (KS2) and attribute variations.

Platform width (KSFB) and platform thickness (KSFD)

The measurements were recorded in millimetres (mm), as indicated in figure 29.

Platform morphology (PMORPH)

The morphology of the core platform is recorded to investigate the choices involved in core preparation and shaping. It can also indicate the core rejuvenation strategy (after Sørensen (2001; 2006) and Damlien (2016a), with adjustments; Table 14; Fig. 30).

No.	Meaning
1	smooth/plain platform
2	faceted platform
3	partially faceted platform

Table 14. Platform morphology (PMORPH) and attribute variations.

Figure 30. Platform morphology (PMORPH) and attribute variations (Illustration: S. Söderlind).

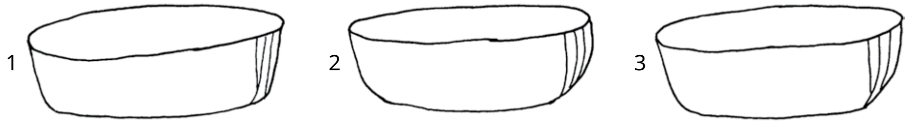


Figure 31. Curvature core front (KABW) and attribute variations (Illustration: S. Söderlind).

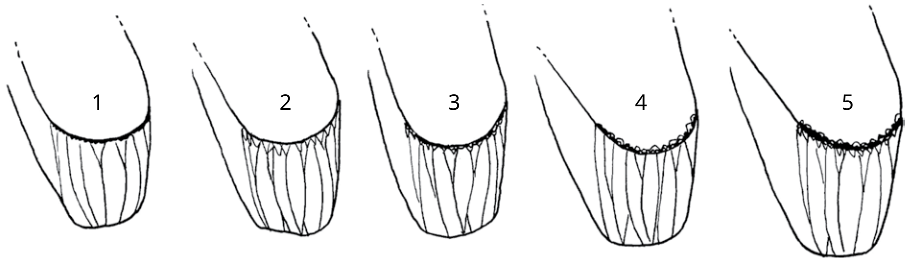


Figure 32. Core front preparation (PPCD) and attribute variations (Illustration: S. Söderlind).

Curvature core front (KABW)

The curvature of the core fronts has significance for the core preparations and blade production. The curvature of the blades has been suggested to relate to the shape of the core front (Andrefsky 1986; De León *et al.* 2009), although the applied force likely plays a role as well (Sollberger and Patterson 1976) (after ZBSA scheme 1.21., with attribute variation 3 added; Table 15; Fig. 31).

No.	Meaning
1	straight
2	even curvature
3	distal curvature

Table 15. Curvature core front (KABW) and attribute variations.

Core front preparation (PPCD)

The core front preparation relates to core preparation and provides insights into the blade production process, specifically indicating how the platform was prepared prior to blade detachment (after Sørensen 2006; 2013, with adjustments; Table 16; Fig. 32).

No.	Meaning
1	abrasion
2	trimming
3	trimming and abrasion (1+2)
4	trimming/abrasion on top of platform by front
5	trimming/abrasion on top of platform by front (4) and additional trimming/abrasion (1/2/3)

Table 16. Core front preparation (PPCD) and attribute variations.

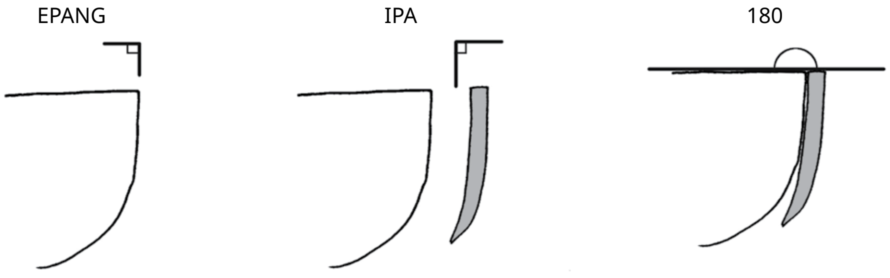


Figure 33. Exterior platform angle (EPANG) and interior platform angle (IPA). Their angles sum up to 180° (Illustration: S. Söderlind).

Exterior platform angle (EPANG)

Experimental studies have shown that the angle between the core platform and front is indicative of different knapping techniques. Angles between 90-100 degrees are useful in order to produce blades using pressure technique (Sørensen 2001; 2006; Pelegrin 2012). An angle of 80-90 degrees corresponds to successful production of larger blades by means of indirect technique, while direct percussion techniques involve angles of between 70-90 degrees (Sørensen 2006).

The work by Damlien (2015) has shown that an interior platform angle (IPA) of blades (Fig. 33) at ≥90 degrees is common in assemblages that are produced using pressure technique (amounting to 88.8% of the blades in the study). For blades that are produced using indirect technique, the same angles are found on 64.4% of the blades. Blades produced by soft direct technique display these larger angles in 29.3-31% of the cases. Meanwhile, for direct hard techniques, the amount is only 1.6%. However, since these angles refer to the interior platform angles of a blade, these angles cannot be directly implemented for the front-platform angle of the cores. However, the corresponding angles can be provided by subtracting the front-platform angle from 180 (degrees) (Fig. 33).

The angle is measured between the core front and the platform. This angle is an important indicator of the knapping technique as certain angles can only be used for certain knapping methods. The angle was measured and rounded to the nearest 5 degrees.

4.1.2.3 Blade information

Remaining parts length (GFL)

This attribute records the remaining parts of the blades in terms of length. Fragments without a remaining proximal part were not recorded due to their limited analytical value (after ZBSA scheme 1.21., with some attribute variations removed; Table 17; Fig. 34).

No.	Meaning
0	incomplete (without specification)
1	complete
2	proximal part
3	proximal-medial part

Table 17. Remaining parts – length (GFL) and attribute variations.

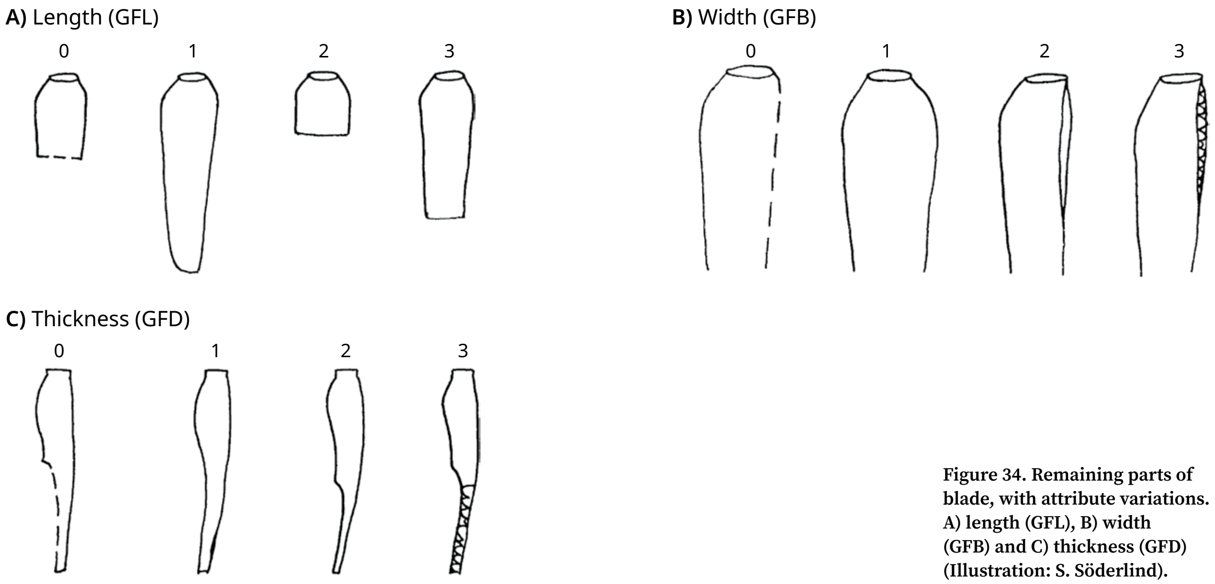


Figure 34. Remaining parts of blade, with attribute variations. A) length (GFL), B) width (GFB) and C) thickness (GFD) (Illustration: S. Söderlind).

Remaining parts width (GFB)

This attribute records the level of fragmentation of the blades in terms of width (after ZBSA scheme 1.21; Table 18; Fig. 34).

No.	Meaning
0	incomplete (without specification)
1	complete
2	incomplete by fracture
3	incomplete by modification

Table 18. Remaining parts – width (GFB) and attribute variations.

Remaining parts thickness (GFD)

This attribute records the level of fragmentation of the blades in terms of thickness (after ZBSA scheme 1.21; Table 19; Fig. 34).

No.	Meaning
0	incomplete (without specification)
1	complete
2	incomplete by fracture
3	incomplete by modification

Table 19. Remaining parts – thickness (GFD) and attribute variations.

Dorsal blade face (DBF)

The variations of dorsal blade faces indicate in which stage of the blade production sequence that a blade has been produced (early, middle or late) and shows how

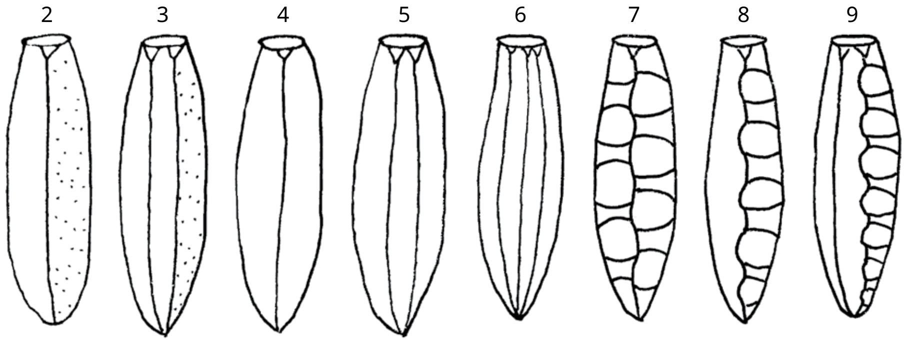


Figure 35. Dorsal blade faces (DBF) and attribute variations (Illustration: S. Söderlind).

the core nodule was prepared prior to knapping. Additionally, the dorsal blade face can provide an idea about the quality and morphology of the raw material (Sørensen 2006). This can also give a further understanding of the raw material economy at the site as well as the regional geology and raw material availability. The amount of different blade variations within an assemblage indicates how long the blade production sequences have been on the site (Sørensen 2013). This attribute was recorded here to understand the initial shaping and preparation of the cores. Attribute morphologies 1, 7 and 10 are created in the early stages of the production process, followed by types 2, 8 and 11. Types 3 and 9 are also created rather early in the production sequence and 4, 5 and 6 are produced in the later stages (*ibid.*; scheme after Sørensen 2006; 2013, with some attribute variations removed; Table 20; Fig. 35).

No.	Meaning
2	two dorsal faces – one with cortex
3	three dorsal faces – one with cortex
4	two dorsal faces (no cortex)
5	three dorsal faces (no cortex)
6	multiple dorsal faces (no cortex)
7	bilaterally crested
8	two dorsal faces – one with crest
9	three dorsal faces – one with crest

Table 20. Dorsal blade faces (DBF) and attribute variations.

Blade termination 1 (BT1)

The blade termination provides an idea of the morphology of the distal part of the core as well as indicating the level of regularity in the blade production (Sørensen 2001; 2006; 2013). An ideal termination is used as a term for a complete blade. Feathered termination is the term for a premature blade termination, often seen as a flattened distal end of a shorter blade. A plunged termination can be described as a late blade termination, and is also known as an overshot. A hinged termination is characterised by a premature break that terminates abruptly, creating a rounded hinge-like end.

Within an assemblage, a large number of ideal terminations indicates a regular blade production, while a large number of variations 2, 3 and/or 4 indicates that cores have been irregular and with short sequences (Sørensen 2013). Reasons for these types of premature blade termination could also include low skills of the knapper or bad quality of the raw material (Eigeland 2015; scheme after Sørensen 2006; 2013 and Eigeland 2015; Table 21; Fig. 36).

No.	Meaning
0	not remaining/broken
1	ideal
2	feathered
3	plunged
4	hinged

Table 21. Blade termination 1 (BT1) and attribute variations.

Blade termination 2 (BT2)

The shape of the distal end can indicate the distal shape of the core that the blades came from. Pointy blade termination indicates that the blade was produced from a conical core, while straight blade terminations indicate that the core is cylindrical, or at least that it has a distal end which is straight and wide (Sørensen 2006). (Scheme after Sørensen 2001; 2006; Table 22; Fig. 36).

No.	Meaning
1	pointed
2	straight

Table 22. Blade termination 2 (BT2) and attribute variations.

Curvature (CURV)

The curvature of the blade is affected by properties of the raw material, the shape of the core nodule and the method and technique used for detaching it (Sørensen 2006; 2013).

Within an assemblage, a high number of straight blades indicates that most of them are made from cylindrical and prismatic core types. Straight blades can also be produced from cores that are distally supported during blade production (Sørensen 2013). Furthermore, straightness in blades, in combination with regularity, is also a common feature of assemblages that are produced using pressure technique (Sørensen 2006; 2013). Blade assemblages with a high amount of distal curvature indicate that direct and indirect techniques have been used. Evenly curved blades are common in assemblages that mainly were produced from cores with single platforms (*e.g.* sub-conical core types) by means of indirect technique, and which lack distal support. Blades that are curved and with a ventral belly are also common in assemblages produced by indirect technique (Sørensen 2013). (Scheme after Sørensen 2001; 2006; Table 23; Fig. 36).

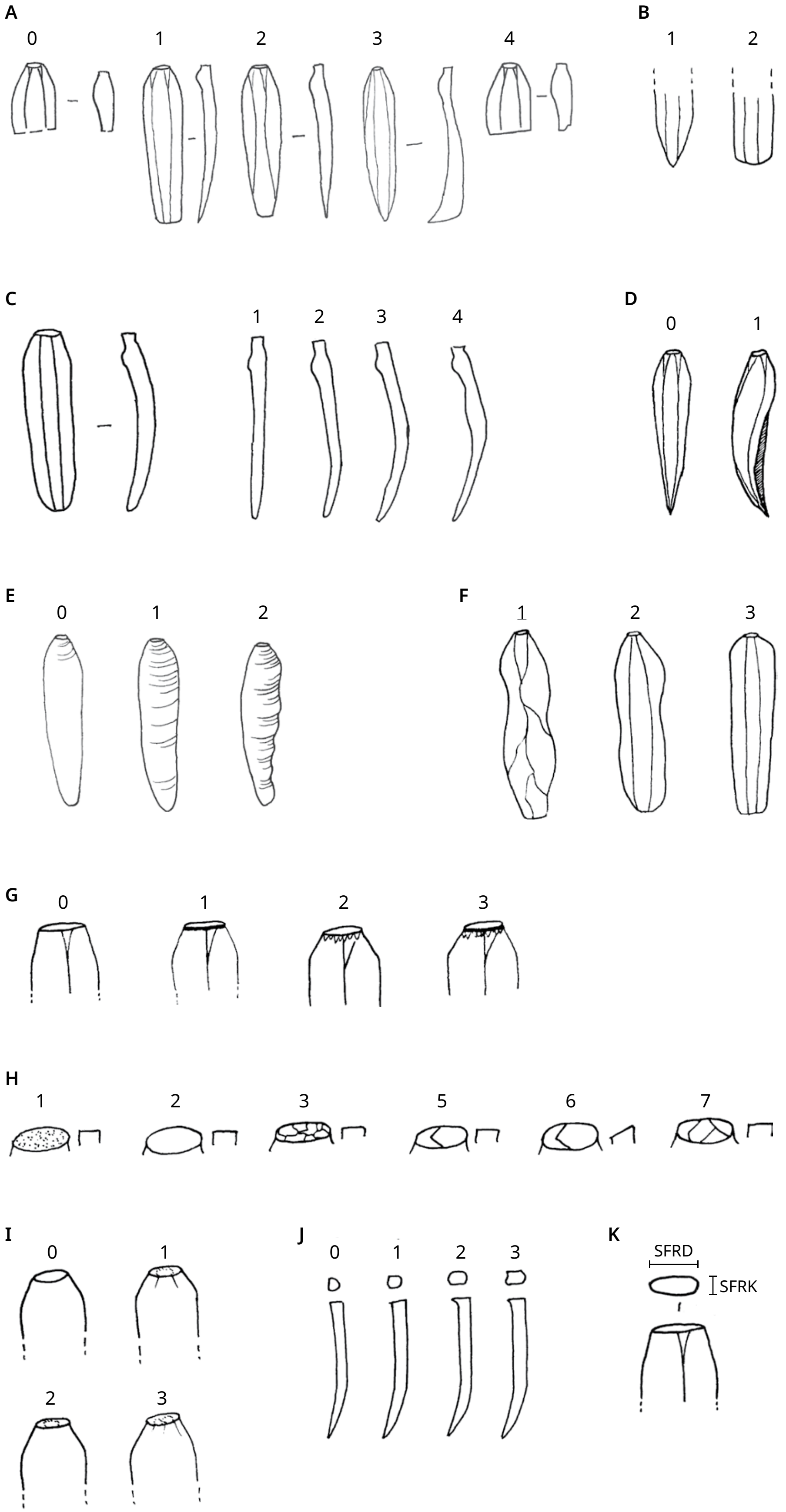


Figure 36. Various blade related attributes, and attribute variations. A) Blade termination 1 (BT1), B) Blade termination 2 (BT2), C) Curvature (CURV), D) Twisting (TWIST), E) Wallner lines (WN), F) Regularity (REG), G) Platform preparation dorsal (SFPD), H) Platform preparations on butt (SFPE), I) Conus formation (KE), J) Lip formation (SL), K) How platform width (SFRD) and platform thickness (SFRK) were recorded (Illustration: S. Söderlind).

No.	Meaning
1	straight
2	distal curvature
3	evenly curved
4	curvature and ventral belly

Table 23. Blade curvature (CURV) and attribute variations.

Blade twist (TWIST)

This is also called proximal twisting. It is observed as a rotation of the blade along its long axis and can occur when the core is not distally supported, and thus moves during blade production. It appears at various degrees of twist from slight to very strong (Damlien 2016a; Berg-Hansen 2017). Here the attribute is simply recorded as present/absent. (Scheme after Berg-Hansen (2017) and Damlien (2016a); Table 24; Fig. 36).

No.	Meaning
0	no twist
1	twisted

Table 24. Blade twisting (TWIST) and attribute variations.

Wallner lines (WN)

Wallner lines, or ventral ripples, are visualisations of the concentric waves that spread in a medium from a point of impact (Inizan *et al.* 1999). Their presence and prominence indicate the hardness of the tool and technique used to detach the blade. M. Sørensen (2013) argued that a larger number of blades with pronounced lines are especially common in assemblages produced by using direct technique with stone hammers (both soft/elastic and hard). Later experiments by Eigeland (2015, 31) have shown that Wallner lines are more common on blades produced using medium hard stone hammers or soft hammers (made of antler, bone, wood or chalk/clay stones), rather than hard stone hammers. They are also very common on products of bipolar (anvil) technique. The Wallner lines appear but are less common on blades produced using indirect technique and pressure technique (*ibid.*). Furthermore, ripples can also be created when blades are produced from an unstable, non-fixed core (Sørensen 2013). Moreover, experiments related to core stability during blade production have shown that untrimmed, and thus weaker core fronts and platforms can provide a similar type of instability in the core (Pelegrin 2006).

Other factors that play a role in the production of Wallner lines include the properties of the raw material. More coarse-grained raw materials, such as quartzite and coarser flint variations, show fewer Wallner lines than fine-grained microcrystalline raw materials (Eigeland 2015; Söderlind 2016) (after ZBSA scheme 1.21; Table 25; Fig. 36).

No.	Meaning
0	no Wallner lines
1	fine Wallner lines, proximally dense
2	pronounced Wallner lines (with/without fine lines (1))

Table 25. Wallner lines (WN) and attribute variations.

Blade regularity (REG)

Blade regularity is recorded based on the joint regularity of the lateral sides and the dorsal ridges of the blade. Blades recorded as irregular blades (1) have irregular lateral sides and dorsal ridges. Irregular blades are common in assemblages that are made using direct/hard techniques. Regular blades (2) have parallel lateral sides or ridges that continue from the proximal to the distal end of the blade. Regular blades are common in assemblages made using indirect technique or pressure technique. Extremely regular blades (3) have parallel sides and dorsal ridges and are common in pressure-made blade assemblages (Sørensen 2013; Eigeland 2015; Damlien 2016a; Berg-Hansen 2017; Table 26; Fig. 36).

No.	Meaning
1	irregular
2	regular
3	extremely regular

Table 26. Blade regularity (REG) and attribute variations.

Platform preparation dorsal (SFPD)

The dorsal platform preparation relates to the knapper's strategy for the preparation of the platform prior to blade detachment. The general goal of the preparation is to remove any overhang, which is the name for any flint protruding from the core platform, after a blade/flake is produced. Overhang makes for a weak platform and is therefore commonly removed to produce a more solid platform for the following blade detachment. The angle between the core front and platform is also adjusted in this process.

Trimming (2) is done by removing small preparation flakes/fragments without creating any deep hinges. Abrasion (1) can be described as a process where a hammer stone is rubbed/driven against the platform edge from the direction of the platform, while removing very small fragments in the process and thus creating a rounded edge towards the front of the core (Sørensen 2013). Trimming and abrasion (3) are a combination of the two (scheme after Sørensen 2006; 2013; Table 27; Fig. 36).

No.	Meaning
0	no preparation
1	abrasion
2	trimming
3	trimming and abrasion (1+2)

Table 27. Platform preparation dorsal (SFPD) and attribute variations.

Platform preparation on butt (SFPE)

Platform preparation or butt preparation (Madsen 1992; Sørensen 2006; Damlien 2016a) indicates the knapper's choice of platform morphology and preparation, as well as the rejuvenation strategy applied throughout knapping (originally from Inizan *et al.* 1999, 134) (after ZBSA scheme 1.21., with some attribute variations removed; Table 28; Fig. 36).

No.	Meaning
0	not remaining
1	natural surface
2	smooth platform
3	crushed
5	faceted – two facets
6	faceted – two facets (tilted)
7	faceted – more than two facets

Table 28. Platform preparations on butt (SFPE) and attribute variations.

Conus formation (KE)

The presence of conus formation indicates that a hard direct technique has been applied to the core (Madsen 1992; Sørensen 2006). However, the creation of conus formation also depends on the characteristics of the raw material. A higher degree of conus formation can be observed in fine-grained raw materials compared to coarser raw materials (Sørensen 2013; Söderlind 2016) (after ZBSA scheme 1.21; Table 29; Fig. 36).

No.	Meaning
0	not conus formation
1	existing – ring crack and ventral fissures
2	existing – visible only on platform
3	double conus formation (1/2)

Table 29. Conus formation (KE) and attribute variations.

Lip formation (SL)

Lip formation was originally introduced as an attribute in combination with bulb formation (Madsen 1992; Sørensen 2006) and later split into two different attributes (Damlien 2016a). The lip is created when the blade detaches from the core and appears with varying pronunciation depending on the tools used for detachment. Typically, the creation of a lip is connected to the use of soft hammers (Sørensen 2013). The combination of lip and percussion bulb has been suggested as a common feature of techniques involving indirect technique with antler (Sørensen 2006). A diffuse lip (1) is difficult to see with the naked eye and is more easily felt by dragging a fingernail towards the edge of the platform from the ventral side of the blade. A pronounced lip (2) can be seen as well as felt with the fingernail (Sørensen 2013; Eigeland 2015). A partial lip (3) is seen or felt with the fingernail on only one side of the percussion bulb (after ZBSA scheme 1.21., with terms from Sørensen 2013 and Damlien 2016a; Table 30; Fig. 36).

No.	Meaning
0	no lip formation
1	diffuse lip
2	pronounced lip
3	partial lip

Table 30. Lip formation (SL) and attribute variations.

Platform width (SFRD) and thickness (SFRK)

The measurements were recorded in millimetres (mm), as indicated in figure 36.

4.1.3 Source critical aspects of technological analyses

Technological analysis is performed by interpreting the attributes observable on the lithic finds. Because of the interpretive character of this method, there is some level of subjectivity involved in the determination due to variations in knowledge and skill of the researcher. Nonetheless, efforts have been made to reduce the level of subjectivity by using an established recording system based on pre-determined attributes and attribute variations. By using such a system, the manner of interpretation is transparent and can thus be understood and possibly reproduced as well as used for comparative studies. Additionally, the raw data collected for this project will also be made available for download from the online JMA "Research Data Exchange Platform" (https://www.jma.uni-kiel.de/en/research-projects/data-exchange-platform) so that other researchers can explore and use the data.

The definitions used for different artefact types, such as "handle core" or "blade," are generally not standardised. Instead, they often depend on the definitions used by individual researchers and institutes which in turn leads to issues of comparability (cf. Sauer and Riede 2018). To counteract these issues, I have made it clear how I define these terms prior to data collection (Chapter 4.1.1).

Another aspect to keep in mind when studying assemblages from older excavations is that information may not have been collected in the same way or to the same extent that it would have been today. Additionally, information is often lost over time. This leads to documentation gaps that may go unnoticed. In this project, materials and radiocarbon dates from older excavations were included when the documentation allowed for an understanding of the applied methods, contextual information, finds and geological processes at the site.

Another source critical aspect, specifically related to this project, relates to language skills. Studies of materials and documentation from across Northern Europe involve publications written in many different languages. Although modern technologies now allow for translation of most languages online, they do not always result in good translations. Therefore, it was sometimes necessary to consult colleagues that could help translate certain texts. Despite all these efforts, it is possible that information was lost or misunderstood in the process of translation.

4.2 Statistical analyses

The data collected from the technological attribute analyses were then explored using both univariate and multivariate analyses, using R studio (Version 1.0.153). This was done to understand which attribute morphologies characterise the handle core concept in different focus areas. The multivariate analyses aided in investigating any unknown associations between different attributes or different focus areas.

4.2.1 Univariate statistics

The initial step in the statistical analyses was to explore any trends or patterns in the data using univariate statistical analyses. This involved mapping the number of finds with different attribute variations from each site, before comparing them within the different focus areas. After that, the data from each focus area was combined to make up a regional technological baseline. These datasets were subsequently compared to provide an understanding of the technological variation of the concept across Northern Europe. The results were summarised in tables and barplots.

4.2.2 Statistical testing and multivariate analyses

After the univariate analyses, the data was examined using several statistical tests to provide comparable values for the relationships between attributes and different focus areas.

To explore the relationships between different attributes and focus areas (represented by nominal/categorical data), two types of chi-square tests were performed, the *Fischer's exact test* and the *Pearson's chi-square test*. The Fischer's exact test was used for the core data since it is recommended for datasets that contain low cell values (Drennan 2010, 192-93). The Pearson's chi-square test is instead recommended when cell values are higher and more variables are used, since it requires less computational power but still results in reliable estimates for p-values (although not as exact as with the Fischer's exact test). The tests provide *P*-values that indicate whether there is an association between two variables (here different attribute variations and focus areas). *P*-values lower than 0.05 show that the null hypothesis (H^0) can be rejected. Since the null hypothesis states that there is no relation between the variables, a rejection of this hypothesis suggests that there is a relationship between the variables. Furthermore, the p-values also indicate how strong that relationship is, with lower p-values reflecting a stronger relationship between the variables. The details of these associations were further explored by comparing expected and observed values for each attribute morphology in each area.

For metric data, associations were instead investigated using several types of t-tests. Firstly, the *Shapiro-Wilks test* was used to test for normality in the data distribution. A normal distribution is confirmed when the probability values exceed 0.05. When it is known whether the datasets have normal distribution, it was possible to continue with a *Wilcoxon Rank Sum Test,* which, by producing p-values, can help indicate if there are associations between metric variables in different focus areas. P-values below 0.05 allow us to reject the null hypothesis

(H_0 = the two populations are equal) and instead accept the alternative hypothesis (H_1= the two populations are different). This means that values higher than 0.05 indicate that the populations are not significantly different, thus indicating some similarities between the means.

To further explore the acquired patterns and to investigate any relationships or groupings within the attribute variations, two types of multivariate analyses were performed, namely a hierarchical cluster analysis and a correspondence analysis (separate for cores and blades). Prior to these analyses, the data was restructured into binary form with each find represented with a series of attributes variations in (1) presence / (0) absence form. Any finds with missing attribute information (indeterminable/ unknown) were removed from the datasets at this stage.

4.2.2.1 Hierarchical cluster analysis

A (hierarchical) cluster analysis was chosen to further investigate the attributes that were previously indicated to be more strongly associated with different focus areas. The main goal of the analyses is to highlight any relationships between certain attributes and certain focus areas in oder to approach an understanding of regional technological traditions relating to the handle core concept.

The hierarchical clusters were computed using the "Ward" method. The distances were calculated using the "binary" method from the "dist"-function available in R. The "binary" method is described in the R documentation as a calculation in which vectors are regarded as binary bits (with 1's representing "on/present" and 0's representing "off/absent"). The distance is the proportion of bits in which only one is on amongst those in which at least one is on. This means that the function takes this binary information, in relation to a core/blade, uses it to compute a distance matrix using the specified distance measure and then computes the distance between the rows of data. Two datapoints which have the presence (1) of an attribute are thus considered to have a smaller distance between them. The higher number of similar attributes that the datapoints share, the smaller the distance is between them. Furthermore, this manner of distance calculation does not consider two datapoints with absent (0) attributes to have a smaller distance, which allows for a focus on the presence (1) of attributes, rather than the absence. This manner of distance calculation represents the *Jaccard's Coefficient* (cf. Drennan 2010, 278-79).

The dendrogram was subsequently cut at different levels to find the most relevant number of clusters. The character of the clusters was then investigated by calculating how many finds from each focus area fell in the different clusters. This was done to understand which datasets were more technologically similar.

4.2.2.2 Correspondence analysis

The goal of this analysis was to reveal any relationships between and within the technological attributes and the various site assemblages in order to further understand any local/regional patterns in the research area. The analysis is useful for an investigation of categorical data, which is why it was chosen here. Furthermore, a correspondence analysis (CA) allows for an estimate of the strength of the relationships.

In the preparation of the correspondence analyses, the datasets relating to each relevant attribute were transformed into contingency tables, ordered by site.

Only the Lithuanian datasets remained grouped as one site (Lith) due to the low number of cores from each site. Subsequently, each dataset was used to calculate a correspondence analysis. The *Principal inertias* (eigenvalues) were produced along with scree plots that indicate the relevant number of dimensions for each plot.

The CA results in a graph showing the attributes and sites plotted on a two-dimensional scale, based on the differences between their expected and observed values (also known as residuals). In addition to these, arrows between the origo point and each plotted point were also drawn. These arrows were then used to understand the presence/absence of any associations between attributes or sites, as well as to indicate the strength of these associations, as based on the length of the arrows.

4.3 Methods to establish a handle core chronology

The establishment of a chronology for the handle core concept was attempted mainly by re-evaluating previously made radiocarbon dates. This re-evaluation focused on both the validity and reliability of the dates themselves as well as the contextual relationship between the dated samples and handle core finds. A small number of AMS-dates were also produced, additionally, to provide a better chronological base for certain contexts.

4.3.1 Evaluating the contextual relationship between sample and find

The issues relating to the fragmented (regional) chronologies of the handle core concept have already been presented (see Chapter 2 and *e.g.* Olofsson 1995; 2003). Because of the fragmented nature of the handle core chronology, an effort was made to investigate the chronology in a more comprehensive manner by gathering available dates and related information from excavation reports, articles and other publications (the result of this effort can be found in Appendix II). However, it should be noted that the list is not comprehensive and should rather be seen as a starting point for the chronological understanding of the handle core concept.

The contextual relationship between each dated sample and the relevant find materials from the different sites were then evaluated according to a ranking system, and placed in one of four (so-called) *Context categories* (CC) (Table 31). These CC were then used for further evaluation, together with the sample evaluations (described below) to map the overall reliability of the dates and samples that make up the handle core chronology on a large spatial scale. The results of these evaluations and further discussion can be found in Chapter 7.

4.3.2 Evaluating the validity and reliability of the radiocarbon dates

A multitude of source critical aspects relate to radiocarbon samples and dates in general. For instance, the use of different sample materials provides varying levels of reliability and possible errors due to marine reservoir effects or an old-wood-effect. Each dated sample also comes with more or less substantial error margins (*e.g.* Taylor and Bar-Yosef 2014, 131-132). All these source critical aspects must be considered before a chronology for a site, context or technology can be reliably established.

Context category (CC)	Reliability of find-context relationship	Description	Example
1	Very good	The dated context is made up of a delimited, short-term used cultural layer, or a feature. The same context contains handle core finds.	The dated context is a hearth in which handle cores were found.
2	Good	The dated context is made up of a delimited, short-term used cultural layer, or a feature. Handle core finds were found in a layer which can be related to the dated layer.	The dated context is a hearth, located inside a hut structure. In the floor layer of the hut, handle cores are found.
3	Okay	The dated context is made up of a delimited, short-term used cultural layer, or a feature. Handle core finds were found in proximity (2-3 meters) to the dated context in the same, or a related layer.	The dated context is a hearth on a dwelling site. Handle cores are found a meter away from the hearth in a related layer or on the same stratigraphic level.
4	Bad	The dated context is made up of a cultural layer, or a feature. Handle core finds were found on the same site as the dated feature.	A context/cultural layer of a site is dated. Handle core finds are found on this site but no other relationship exists between the date and the finds.

Table 31. Context categories (CC 1-4) with related reliability levels, brief descriptions and examples used for each analysed context.

Systems have been developed to deal with these aspects, such as the one by Seitsonen *et al.* (2012). The system by Seitsonen *et al.* (2012) evaluates each sample and date based on a series of source critical aspects. Based on these evaluations, each sample is subsequently categorised as “good”, “bad” or “weird” and interpreted accordingly. For this project, I created a similar but simplified system compared to the one by Seitsonen *et al.* Their system could result in a total score of 28 (very reliable), while the system implemented in this thesis amounts to 10 points in total. The system by Seitsonen *et al.* (2012) can thus be considered more precise, as it takes more critical aspects into account when evaluating the samples. However, their system also requires more detailed information regarding the samples, dates and applied excavations techniques for successful evaluation. This type of information was, unfortunately, unavailable for most of the samples collected under the scope of this project. Therefore, a simplified *Sample Evaluation* (SE) system was created (Table 32) with inspiration from Seitsonen *et al.* to nonetheless be able to evaluate the reliability of the samples and dates.

These sample evaluation points were then used in a further evaluation, alongside the context categories (described above), to map the overall reliability of the dates and samples that make up the handle core chronology on a large spatial scale. The results of these evaluations and further discussion can be found in Chapter 7.

SE 1	**Sample material: anthropogenic or not?**
3	Artefact
2	clearly related to anthropogenic activities
1	charcoal from cultural layer (free-floating)
0	no clear relation to anthropogenic activities
SE 2	**Missing information regarding sample material**
2	sample material is known (type and sub-types)
1	sample material is known (type)
0	sample material is unknown
SE 3	**Old wood effect/old sample age**
1	can be ruled out
0	cannot be ruled out
SE 4	**Reservoir effect**
1	can be ruled out
0	cannot be ruled out
SE 5	**Standard deviation/error margin**
3	less than 50
2	between 50-70
1	between 70-100
0	more than 100

Table 32. Sample evaluation (SE 1-5) system used for each analysed radiocarbon sample/ date.

4.3.3 New AMS-dates

To further the understanding of the chronology of the handle core concept in Northern Europe, some additional radiocarbon dating of organic samples was carried out from the sites Ljungaviken (in Southern Sweden) and Stanovoye 4 (in Western Russia). Detailed sample information and resulting dates will be presented and discussed in Chapter 6.

The labs use standardised methods for physical/chemical pre-treatment of samples, combustion to CO2, graphitisation and finally AMS-measurements. Detailed information about these processes can be found at the lab websites: https://www.leibniz.uni-kiel.de/en/ams-14c-lab/sample-submission#Pre-treatment%20 procedures (Kiel lab) and https://radiocarbon.pl/en/sample-preparation/ (Poznan lab, both visited on 08.09.2021).

The resulting (AMS) C14-ages from the labs were further calibrated using *OxCal version 4.4.4* (Bronk Ramsey 2021), using atmospheric data from Reimer *et al.* (2020). Dates are reported throughout the dissertation as calibrated ranges (cal BCE), using two standard deviations (2σ).

5 Materials

The materials used for this study were collected from several focus areas, which are presented in this chapter (5.1) along with the reasonings behind the selection of materials (5.2). The representativity of the assemblages will also be discussed (5.3), before the sites, from which materials were recorded, are briefly presented (5.4).

5.1 Focus areas within the research area

To understand the technological character of the handle core concept in Northern Europe, assemblages from 23 sites were analysed. Sites and assemblages were chosen from five focus areas (F1-5) that were selected for more focused investigations in different parts of the research area (Fig. 37). During the project, one focus area (5), centred in Northern Poland, was discarded due to a lack of data, while another area was divided into two separate focus areas (details below).

Focus area 1 is represented by the Upper Volga region in Western Russia. This area was chosen due to previously published research that indicates the presence of handle cores in the Early Mesolithic (Butovo) assemblages (Averin and Zhilin 2001; Zhilin 2002; 2007; 2009; Zhilin and Matiskainen 2003). A total of five site assemblages were investigated from the focus area: Stanovoye 4, Butovo 1, Zabarovie 2, Ozerki 5 and Ust-Tudovka 4. However, single-fronted cores were only found at Stanovoye 4, which means that the data from this focus area is represent-

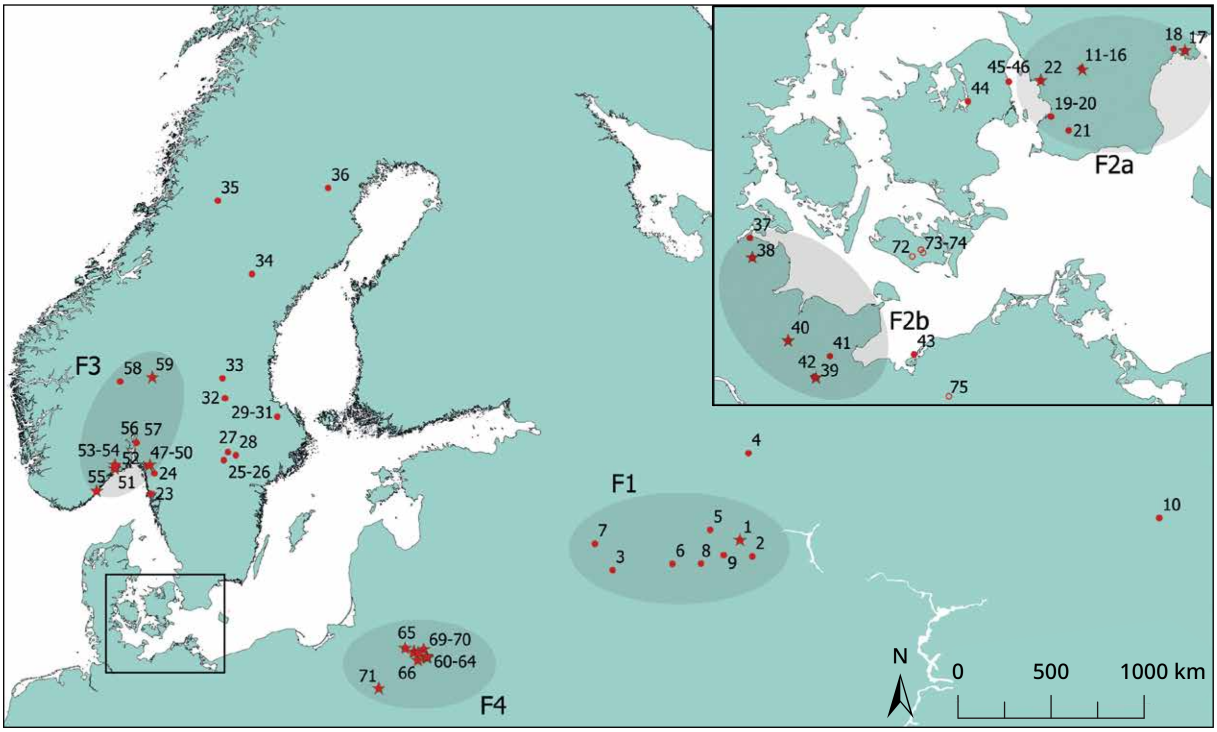


Figure 37. Location of the sites with handle cores or single-fronted cores mentioned in the text. Sites marked with a red star underwent technological analysis. Shaded areas represent the four final focus areas (F1-4). Numbers represent the sites: 1) Stanovoye 4; 2) Sakhtysh 14; 3) Ust-Tudovka 4; 4) Veretye 1; 5) Zolotoruchye 1; 6) Ozerki 5 and Zabarovie 2; 7) Podol 3; 8) Okayomovo 4; 9) Ivanovskoye 7; 10) Beregovaya 2; 11-16) Ageröd I:B; Ageröd I:D; Ageröd V; Rönneholm 6-8; 17) Ljungaviken; 18) Årup; 19-20) Segebro, Arlöv; 21) Bökeberg III; 22) Tågerup 1:1; 23) Dammen; 24) Storsand R54; 25-26) Svartkärret 1, Svartkärret 3; 27) Mogetorp; 28) Lysinge 1; 29-31) Stormossen 1, Stormossen 5, Stormossen 5:2; 32) Limsjön; 33) Ore 527; 34) Ramsele RAÄ 128 (Lafssjön); 35) Nyluspen 1:10 RAÄ 553; 36) Garaselet; 37) Rüde LA 2; 38) Satrup LA 2; 39) Dreggers LA 3; 40) Owschlag LA 183; 41) Seedorf LA 296; 42) Bebensee LA 76; 43) Jäckelberg-Huk; 44) Blak 1; 45-46) Gøngehusvej 7, Vænget Nord; 47-50) Berget 1, Torpum 9A-9B, Lokalitet 3 (Halden excavations); 51) Stokke-Polland 8; 52) Langangen Vestgård 3; 53-54) Vallermyrene 1, Vallermyrene 4; 55) Krøgenes D2; 56) Trosterud lok 1; 57) Kvestad lok 3; 58) Dokkfloy DR291; 59) Stene terrasse; 60-64) Dubiciai 1 (Salaitė), Gribasa 4, Katra 1, Margiai 1-2; 65) Dusia 8; 66) Kabeliai 1; 67-68) Maksimonys 4, Netiesai 1; 69-70) Papiskes 4, Varėna 2; 71) Grady-Woniecko.

ed only by one site. The sites, from which data was recorded, are all presented at the end of the chapter (5.4).

Focus area 2a is represented by Southern Sweden (provinces Scania, Blekinge and Halland). The area was chosen due to the already known distribution of handle cores in the Mesolithic assemblages. A total of 3 site assemblages were recorded from the area: Tågerup, Rönneholm 6 and Ljungaviken.

Focus area 2b is represented by Northern Germany, mainly limited to the state of Schleswig-Holstein, but also including parts of Mecklenburg-Western Pomerania. The area was chosen due to the already known distribution of handle cores in the Mesolithic assemblages. A total of 3 site assemblages were recorded from the area: Satrup LA 2, Dreggers LA 3 and Owschlag LA 183. The reasoning behind naming the focus areas 2a and 2b as such, was due to the initial plan to include Southern Sweden, Denmark and Northern Germany as one focus area (focus area 2). Previous studies have already shown strong technological similarities between these areas (Larsson 1978; Olofsson 1995, 50-51; Sørensen 2006; Frandsen 2015; Ballin 2016; Söderlind 2018). However, a lack of datable sites from Denmark did not allow for a joint focus area across these regions, which is why it was instead divided into two focus areas: 2a (Southern Sweden) and 2b (Northern Germany). Nonetheless, it is assumed that strong technological similarities exist between all these areas, especially between Zealand (Denmark) and Scania (Sweden), as shown in the already mentioned previous research.

Focus area 3 is represented by southern and eastern parts of Norway (counties: Innlandet, Viken, Vestfold og Telemark and Agder). The area was chosen due to the known distribution of handle cores in the assemblages. A total of 5 site assemblages were recorded from the area: Halden Lokalitet 3 (or Lokalitet 3, Halden excavations), Krøgenes D2, Stene terrasse, Stokke/Poland 8 and Vallermyrene 4.

Focus area 4 is represented by Southern Lithuania (counties Marijampolė, Alytus, southern Vilnius and southern Kaunas). This area was chosen due to previously published research that indicated the presence of single-fronted cores or handle cores in the area during the Mesolithic. A total of 11 site assemblages (all listed below) were recorded from the focus area.

Focus area 5 was represented by Northern Poland (Central European Plain). This area was chosen due to the existence of previously published handle core finds (*e.g.* Galiński 1992) and also because of its location between Southern Lithuania and Northern Germany, areas where handle cores had been already confirmed in previous research (for Northern Germany) or were to be investigated in the course of the current project (for Southern Lithuania). A total of 5 Mesolithic assemblages were thoroughly investigated: Janislawice, Grądy-Woniecko, Kopanica 29, Krzyż and Dąbki 9. Additionally, several smaller site assemblages were briefly searched for relevant materials. Only the assemblage from Grądy-Woniecko contained finds that resemble handle cores. From this site, a handful of cores/preforms were found in a deposit, but the concept does not seem to have been implemented for blade production on the site. The few finds of possible handle cores from the site were, however, not considered substantial enough to confirm a general presence of the handle core concept within the focus area. It should also be noted that the already mentioned publication by Galinski (1992), which indicates the presence of handle cores in assemblages in Northwestern Poland, could unfortunately not be investigated in this project.

5.2 Selection of materials and assemblages

The sites from the different focus areas were chosen based on the presence of handle cores and handle core blades in the assemblage. Most sites were also chosen due to the presence of dated/datable materials in spatial relation to handle core finds. However, focus area 4 was included despite the presence of datable materials for reasons of potential technological comparability and regional patterning.

Each material study was carried out using the same process. First, the full site assemblage underwent an *overview study* (1). This was done whenever the full assemblage was available for study and it was not too extensive. This involved a visual inspection of the complete assemblage, noting the presence of available find types, raw materials and any other features that might be of relevance for understanding the activities on the site. If single-fronted cores were observed during this overview study, the *technological attribute analysis* (2) followed. During the technological attribute analyses, the finds were recorded according to the established recording scheme (see Chapter 4.1.2).

Whenever possible, both cores and blades were recorded from each assemblage. However, in some cases it was not possible to record both blades and cores from the same assemblages, for varying reasons. For instance, the blades from Stanovoye 4 were not available for study at the time of recording, and were

Focus area	Site name	Country	Overview study of material	Technological attribute analysis	New AMS-dates	Previously dated	No. of cores	No. of blades	No. of finds tot
1	Stanovoye 4, layer IV and III	Russia		x	x	x	27	0	27
1	Butovo 1	Russia	x			x	0	0	0
1	Zabarovie 2	Russia	x				0	0	0
1	Ozerki 5	Russia	x			x	0	0	0
1	Dorki 9	Russia	x				0	0	0
1	Ust-Tudovka 4	Russia	x			x	0	0	0
Focus area 1 total no. of recorded finds							*27*	*0*	*27*
2a	Ljungaviken	Sweden	x	x	x	x	12	119	135
2a	Tågerup	Sweden		x		x	135	191	326
2a	Rönneholm 6	Sweden		x		x	25	431	456
Focus area 2a total no. of recorded finds							*172*	*741*	*913*
2b	Satrup LA 2	Germany	x	x		x	6	347	353
2b	Dreggers LA 3	Germany	x	x			54	0	54
2b	Owschlag LA 183	Germany	x	x			3	0	3
Focus area 2b total no. of recorded finds							*63*	*347*	*410*
3	Halden Lok 3	Norway		x		x	54	0	54
3	Krøgenes D2	Norway		x		x	6	40	46
3	Stene terrasse	Norway		x		x	3	17	20
3	Stokke/Poland 8	Norway	x	x		x	5	58	63
3	Vallermyrene 4	Norway	x	x		x	11	270	281
Focus area 3 total no. of recorded finds							*79*	*385*	*464*
4	Dubiciai 1	Lithuania	x	x			1	0	1
4	Dusia 8	Lithuania	x	x			1	0	1
4	Gribasa 4	Lithuania	x	x			1	0	1
4	Kabeliai 1	Lithuania	x	x			1	0	1
4	Katra 1	Lithuania	x	x			6	0	6
4	Maksimonys 4	Lithuania	x	x			2	0	2
4	Margiai 1	Lithuania	x	x			17	0	17

Focus area	Site name	Country	Overview study of material	Technological attribute analysis	New AMS-dates	Previously dated	No. of cores	No. of blades	No. of finds tot
4	Margiai 2	Lithuania	x	x			7	0	7
4	Netiesai 1	Lithuania	x	x			9	0	9
4	Papiskes 4	Lithuania	x	x			1	0	1
4	Varėna 2	Lithuania	x	x			1	0	1
Focus area 4 total no. of recorded finds							*47*	*0*	*47*
5	Grądy-Woniecko	Poland		x		x	5	0	5
5	Janislawice grave	Poland	x			x	0	0	0
5	Kopanica 29	Poland	x			x	0	0	0
5	Krzyż	Poland	x			x	0	0	0
5	Dąbki 9	Poland	x			x	0	0	0
*Focus area 5 total no. of recorded finds – **discarded as a focus area***							*5*	*0*	*5*
Summary all focus areas (excl. F5)		***5***	***22***	***23***	***2***	***13***	***388***	***1473***	***1861***

Table 33. Sites included in this study listed with the types of performed analyses and available data.

thus not recorded. Furthermore, the blade assemblages from Dreggers LA 3 and Owschlag LA 183 were recorded, but in a different manner than the rest of the blades, since they were recorded as a part of a preliminary study, prior to the start of this project. Therefore, this data could not be used for technological comparisons. The blade assemblage from Lokalitet 3 (Halden excavations) as well as all of the Lithuanian sites were excluded due the mixed character of the sites, which contained various core types with different chronological settings. Furthermore, during the first technological analyses (Ljungaviken), all blades from the site were recorded, without regarding their size. After the analysis, it was decided to record only blades that fall within the general size spectrum indicated by the core heights (L) of each site. Rejuvenation flakes from handle cores were also recorded, following the scheme related to the cores (and are included in the core dataset above).

5.3 Representativity of the materials

The materials recorded in this study must be understood as only a partial representation of a much more extensive assemblage during the Mesolithic. Various taphonomic processes lead to the loss of significant portions of the materials (organic and otherwise) that once existed on the sites. Depositional and post-depositional mechanical factors, such as roots and digging animals, can move artefacts around, in and between the archaeological layers. Additionally, excavations often result in only partial site representations, both in terms of limited excavation areas as well as methods and techniques that reduce the overall representativity of the site. Post-excavation treatments, such as find recording, find storage, and preservation efforts, can lead to further losses of information (Taylor and Bar-Yosef 2014, 137). Some of these aspects, and their implications for data representativity, will be discussed in detail here.

5.3.1 Focus areas and sites

The reasons for selecting the focus areas and assemblages in the research area have already been presented in this chapter. Nonetheless, the selection of focus areas and sites is clearly limited for such a large research area and can thus only provide a partial understanding of the technological and chronological patterns that are related to to the HCC. The materials and methods used in this project will also mainly focus on technological variation and trends on a large spatial (supra-regional) scale.

Additionally, the variation in site activities or seasonality at different sites will not be investigated in this project. Variations between the datasets from different sites could therefore partly reflect differences in activities on the site. Furthermore, sites with longer site chronologies or repeated settlement will produce larger and more varied assemblages than sites that were used briefly, due to sample size effect (*e.g.* Grayson 1981). Therefore, such aspects need to be discussed in relation to the results of the data analyses (in Chapter 7).

Variability in assemblages might also reflect patterns of import or export of finds between sites or regions. In this study, efforts have been made to focus on assemblages that contain both handle cores and blades to confirm the implementation of the concept on the site, rather than mapping the distribution of mobile single finds. Nonetheless, the possibility exists that cores and blades were created somewhere only to be transported and implemented somewhere else. These patterns will not be explored in this project since they would require more comprehensive studies of the *chaîne opératoire* from each site. The best way for an understanding of the various knapping processes, in detail, would have been through the implementation of assemblage refitting. However, such studies are very time consuming and therefore it was not possible to conduct them under the scope of this study.

5.3.2 Finds within assemblages

The varying number of finds and types of finds (cores and blades) from each site and focus area created difficulties in their comparability within and between focus areas. Some focus areas are represented by multiple sites and larger site assemblages, while other focus areas are only represented by single sites and small assemblages (see Table 33). This clearly results in limited comparability between the areas and sites, and subsequently less statistically reliable results. Nonetheless, the data from the different focus areas will provide an idea of the technology from the different focus areas, despite the varying amounts of cores and blades from different sites.

5.4 Site descriptions

Here, the sites from each focus area will be briefly presented. The presentations will include basic information regarding finds, chronology and site stratigraphy. Source critical aspects related to the sites will also be highlighted.

5.4.1 Focus area 1 – Upper Volga region

5.4.1.1 Stanovoye 4

The site is situated in the Ivanovo area of the Upper Volga region in Western Russia. It is located on a promontory that reaches into the Podozerskoye peat bog, which was a glacial lake during the Early Holocene. Today, the Lahost River also runs through the site. Stanovoye 4 was excavated between 1993 and 2002 and has been extensively published since then (*e.g.* Averin and Zhilin 2001; Zhilin 2002; 2007; 2009; Zhilin and Matiskainen 2003). The site stratigraphy consists of three Mesolithic layers (IV, IIIa and III) and one layer (II) dating to the so-called forest-Neolithic (Fig. 38). The chronology of the site is based on a multitude of radiocarbon dates (all dates used in this project can be found in Appendix II) and stretches from the end of the Younger Dryas or Early Preboreal (mid-11th to mid-10th millennium cal BCE) until the Early Atlantic (first half of the 6th millennium cal BCE) (Hartz *et al.* 2010; Zaretskaya *et al.* 2005; Söderlind and Zhilin 2021).

The oldest cultural layer (IV) contains flint, stone and bone artefacts related to the early Butovo technocomplex. Blanks were made from blades and flakes produced from sub-prismatic double-platform cores by means of indirect technique and pressure technique (Zhilin 2009; Hartz *et al.* 2010). These blanks were further worked into various tools, including scrapers, burins, tanged points and axes/adzes. Additionally, a rich osseous assemblage is represented by slotted bone points, fragments of lance points, daggers, knives, antler axes/adze blades, sleeves, awls, scraper-knives made from beaver mandibles, antler pressure flakers, punch tools, a wedge and a harpoon preform (Zhilin 2009). Drawings of

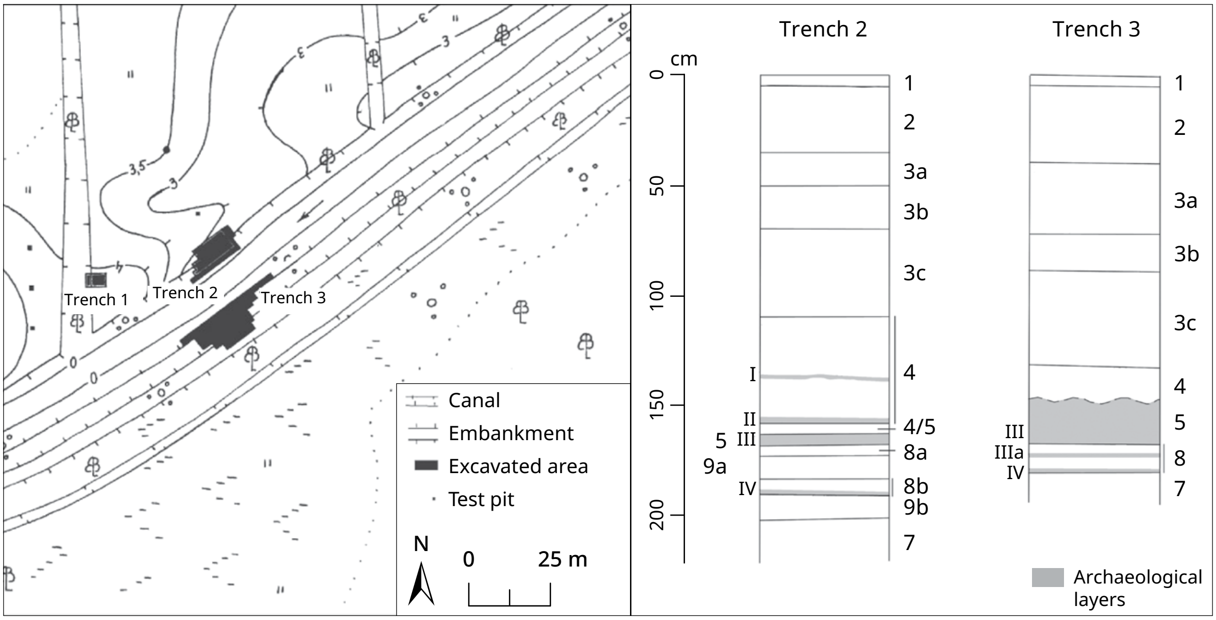


Figure 38. Overview plan and stratigraphy of Stanovoye 4 (trenches 2 and 3) with archaeological layers (after Zhilin and Matiskainen 2003; Söderlind and Zhilin 2021). The numbers relate to the character of the sediments, 1) Modern soil, 2) Ground removed from the artificial bed of the Lahost River, 3a) Brown peat with gyttja, 3b) Grey clay, 3c) Brown gyttja, 4) Dark brown gyttja with thin lenses of yellow sand, 4/5) Yellow alluvial sand, 5) Black gyttja, 7) Gravel, boulders – washed moraine, 8a) Dense brown gyttja, 8b) Brown gyttja changing into grey silt, 9a) Grey sand with lenses of silt, 9b) Grey sand with lenses of silt.

artefacts from layer IV have indicated the presence of single-fronted cores (*e.g.* Averin and Zhilin 2001; Hartz *et al.* 2010).

The subsequent habitation layer, IIIa, is interpreted as relating to the Ienovo technocomplex. It contains a smaller number of finds, including a few chert flakes, a flint knife, scrapers, an asymmetric trapeze, an oblique one-edged arrowhead as well as some bone and antler finds (Zhilin 2003).

An earlier habitation layer, III, has been interpreted as belonging to a later stage of the Butovo technocomplex. Finds include a typical tanged "post-Swiderian" point, perforated and grooved tools, scrapers, burins, knives, perforators, inserts, oblique points, core- and polished axes, adzes and chisels, hammer stones, sinkers and combination tools. Osseous tools are represented by bone points, barbed points, daggers, knives, fishing tools, scrapers, awls, needles, antler axes/adzes, chisels, *etc.* (Zhilin 2003; Zhilin and Matiskainen 2003). Finds from this layer also include single-fronted cores.

The final habitation layer is cultural layer II. In this layer, a small number of flint and osseous materials were found along with thick-walled ceramic fragments. This layer is interpreted as representing an early stage of the Early Neolithic Upper Volga cultural complex (Zhilin and Matiskainen 2003).

Source critical aspects relating to the data/site: This focus area is represented by only one site, which clearly limits the potential for understanding the materials on a regional scale. Additionally, the recorded assemblage from the site is small, which further limits the potential for generalisability and comparability to other sites and focus areas.

The chronology of the stratigraphic layers that contains the relevant finds also seems to have accumulated over a longer period, which leads to less exact chronologies for the single-fronted cores. The relevant cores were found in two separate archaeological layers, which were dated to ca. 10,000-9500 cal BCE (layer IV) and ca. 8800-7600 cal BCE (layer III). These layers thus span ca. 500 and 1200 years, respectively, making the chronology of the finds imprecise. It is, furthermore, likely that the core type was also used between these different phases, but they are just not represented at this specific site. The two implementation phases, along with the time between them, would accumulate to a total regional chronology of at least 2400 years. Furthermore, since the artefacts cannot be tied to any features or more limited contexts than the archaeological layers, it is not clear if the cores and blades were produced sporadically during this long time period, or just had two shorter implementation phases.

5.4.2 Focus area 2a – Southern Sweden

5.4.2.1 Ljungaviken

The Ljungaviken site (official name: RAÄ Sölvesborg 74) is located in the south-western part of the province Blekinge, in Southern Sweden, and was excavated in 2007, 2010, 2015, 2016, 2018 and 2020 (Björk and Pettersson 2008; Kjällquist 2010; Friman and Lagerås 2015; Kjällquist and Friman 2017; Persson *et al.* 2018).

This extensive settlement site has a rich inventory and was settled repeatedly during the Mesolithic for short-term visits at different times of the year. During excavations, the remains of ca. 60 huts and houses, dating to ca. 6700-5700 cal BCE, were found (Kjällquist and Friman 2017; Olsson 2020). The final stages of

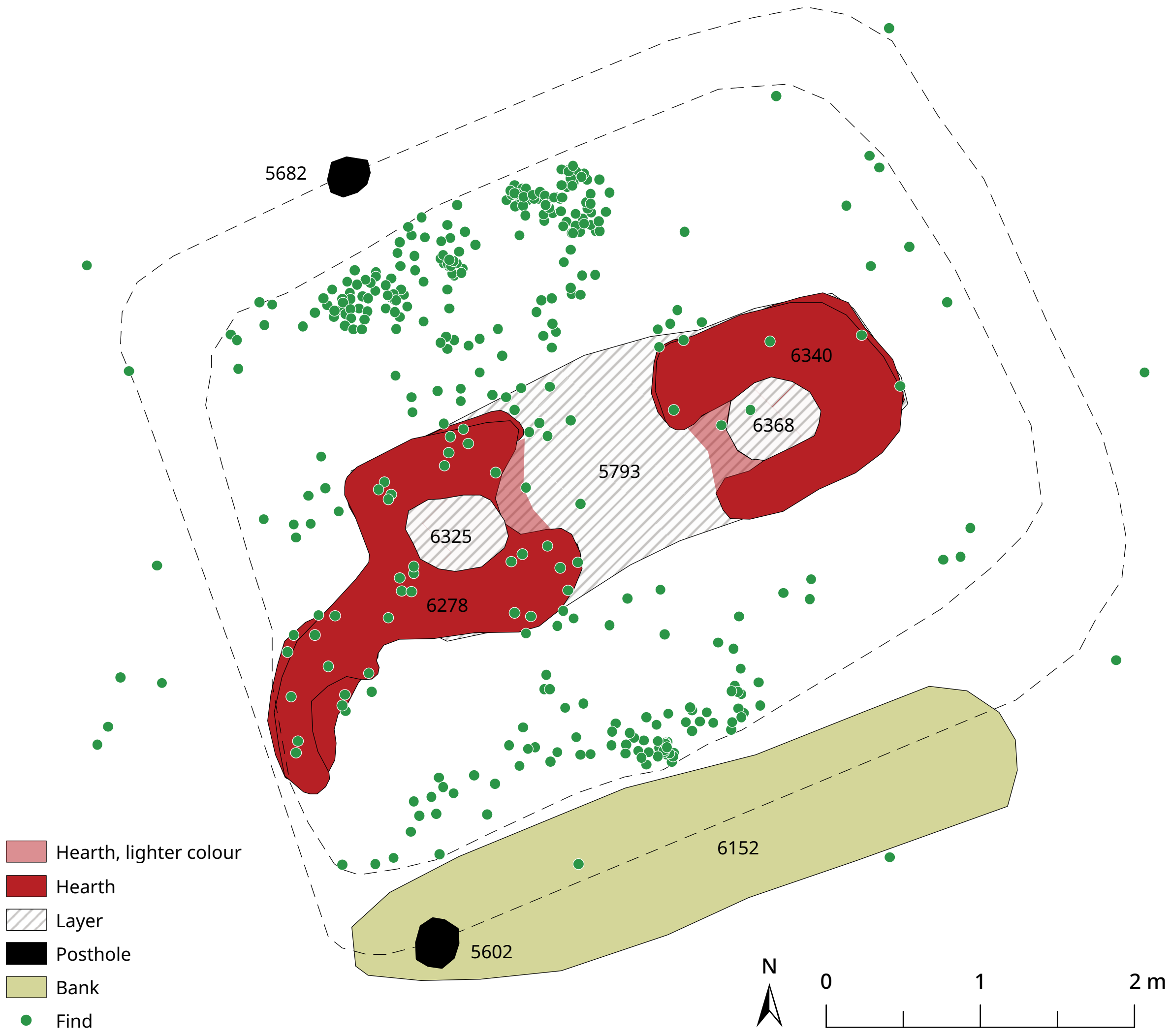


Figure 39. Find distribution and features around Hut 3 at Ljungaviken (after Kjällquist and Friman 2017, fig. 19).

the site date to ca. 5800-5700 cal BCE when the Littorina transgression flooded the site, covering it with a 1.5 m thick sand layer. On top of this sand layer, a thin clay/gyttja layer also helped preserve the settlement while keeping the artefacts *in situ* (Friman and Lagerås 2015; Lagerås, in Kjällquist and Friman 2017, 32).

Activities reflected in the assemblage include the making and maintenance of tools for hunting and fishing, which are also supported by use wear traces on the lithics. Finds were mainly made from local Kristianstad flint and non-local South Scandinavian flint. Additionally, a small number of finds were made from quartz and other rock types (Kjällquist and Friman 2017, 18). The lithic assemblage from the site indicates a general focus on blade- and microblade production. Other artefacts include blade burins, flake scrapers as well as individual finds of borers, axes and knives, pendants, grinding stones and hammer stones. Blades were often segmented via breaking or by means of microburin technique. Microlith types mainly consist of lanceolates and non-determinable types, but single trapezes and transverse arrowheads were also found (Kjällquist and Friman 2017, 18-19).

Several cores and rejuvenation flakes clearly related to the handle core concept were found in relation to Hut 3 (Fig. 39), along with smaller blades that have been interpreted as relating to the same concept. The hut dates to around 5900-5650 cal BCE, based on previous radiocarbon dating and shoreline displacement chronology (Lagerås, in Kjällquist and Friman 2017, 48). However, four of the previously dated samples from in and around the hut resulted in unexpected and conflicting dates (*ibid.*, 52). Therefore, further samples from this context went on to be dated (see Chapter 6.2.2).

Source critical aspects relating to the data: Although Hut 3 is used as a clearly limited context, related to the implementation of the handle core concept and the making of slotted bone points, it has limitations in that the number of finds from that context was too small for reliable statistical analysis. Therefore, the find recording was expanded to include finds from the entire site, which might result in the materials representing a broader time frame than the one suggested by the dates from Hut 3. Additionally, the finds may show variation due to seasonality, variety over time or due to variation in social and technological traditions of the people who visited the site.

5.4.2.2 Tågerup

The site is located on the western coast of Scania, in Southern Sweden. Surveys and excavations took place between the years 1995 and 1998. A total of 23,000 m^2 have been excavated (Karsten and Knarrström 2001; 2003).

The taphonomic conditions of the site were similar to the ones at Ljungaviken. Tågerup is also situated in sandy soils, which normally would create poor conditions for organic remains. However, due to the site being covered by layers of marine clay/gyttja which acted as a protective lid, a larger portion of organic remains have been recovered from the cultural layers below (Karsten and Knarrström 2003, 30).

Most of the assemblage from the site comes from (ca. 120 cm) thick cultural layers, indicating that the site was used continuously during a longer time. The

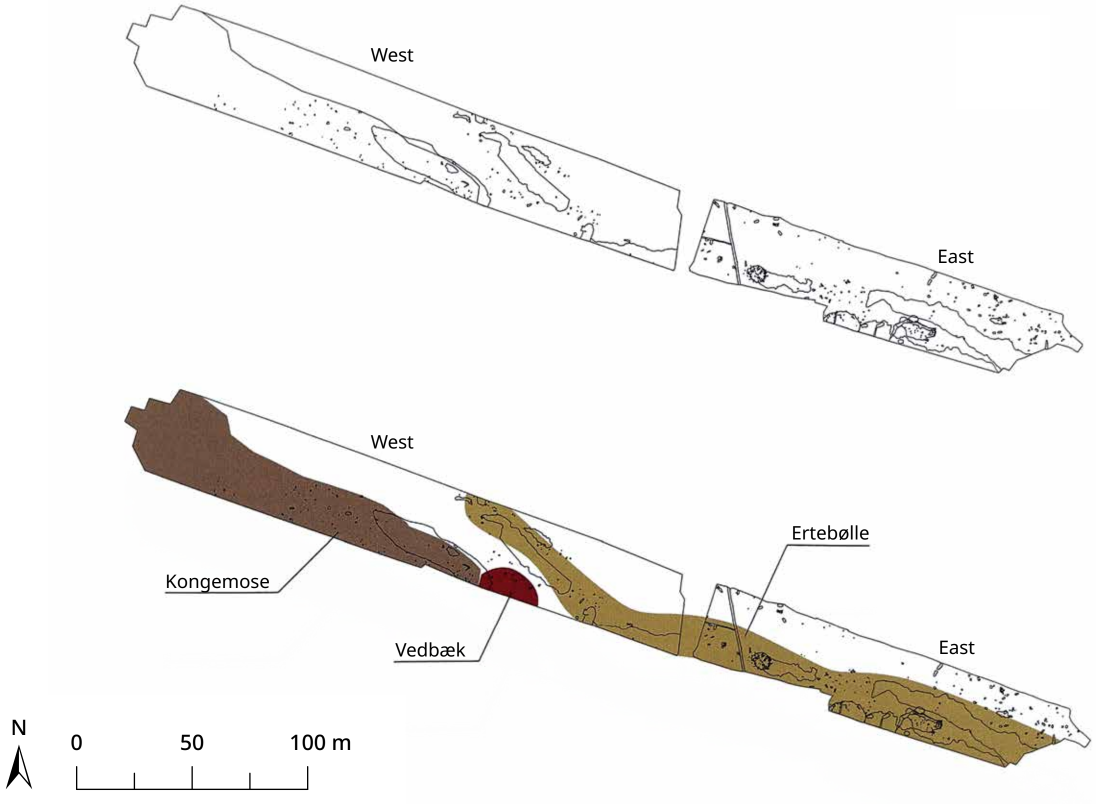


Figure 40. Overview map of Tågerup displaying the distribution of the western Kongemose layers and the eastern Ertebølle layer (Karsten and Knarrström 2003, 29).

typology and technology of the site indicate a chronology spanning both Kongemose and Ertebølle periods, from ca. 6200 cal BCE to 4500/4000 cal BCE (Karsten and Knarrström 2003, 35, 130). The cultural layers also have different spatial distributions, which divide the site into a Kongemose area and an Ertebølle area (*ibid.*, 28; Fig. 40).

In the Kongemose area of the site, the debitage assemblage largely consists of blades, flakes, different types of cores (incl. over 300 handle cores and fragments), microflakes and other fragments. There is a clear focus on blade production, with 20% of blanks represented by blades and microblades. Formal flint tools include retouched blanks, scrapers, cutting-tools, burins, hammer stones and microliths (types include trapezoid, rhombic/oblique, and oblique transverse arrowheads). The organic remains include antler punches, pressure tools, different types of bone points, awls, a dagger, a decorated axe shaft of antler, other decorated pieces of bone and tooth, and a wooden pointed object. No remains of structures were found in this part of the site (Karsten and Knarrström 2003, 37-49, 54-118).

The Ertebølle area mainly contains finds related to the production of flakes, most of them produced using direct hard technique. The formal finds are represented by knives, scrapers and burins, transverse arrow heads and axes (*ibid.*, 142-211). Organic finds include a hafted pressure tool, net floats, beads and an antler socket. In this phase of the site, there is also a clear increase of wood working seen by decorated wood, tar torches, poles, fishing traps and fish weirs, leisters, fragments of arrows, *etc.* (Karsten and Knarrström 2003, 142-211). In addition to the focus on flake production, microblades and related remains were also found in these contexts, along with 27 handle cores, making Tågerup one of few sites where handle cores have been found in Ertebølle contexts (Karsten and Knarrström 2003, 139-142). Possibly, these finds relate to the very beginning of the Ertebølle phase and the final stage of blade production related to the handle cores.

The western part of the eastern (Ertebølle) area also contains five Mesolithic graves. Grave 1 is of special interest since a handle core and a related flake have been found in relation to the grave. The grave contains the remains of a 45-50-year-old woman. The handle core itself was found in the posthole that was placed over the grave, interpreted as a grave marker. The flake, which is made of the same unique flint type, was instead found in the grave filling. These finds have been interpreted as grave goods (Kjällquist 2001, 37-40, 68). Unfortunately, the bones in the grave could not be dated due to low collagen levels. Instead, one single (undetermined) charcoal fragment dates the filling of the grave to 6461-6170 cal BCE (Ua-9946 – 2 sigma range) (Kjällquist 2001, 38).

Additional source critical aspects relating to the data: Assemblages from the site accumulated during an extensive amount of time. The finds and dated samples (related to the Kongemose area) come from thick archaeological layers rather than short-term contexts or features, which does not allow for a detailed chronological understanding of the materials.

This site is also one of few sites where handle cores have been found in Ertebølle layers. What does the presence of handle cores in the Ertebølle contexts represent? Were they used at the very early stage of Ertebølle settlement, before the technology is discarded? Perhaps they could be the result of scavenged finds or the “reading of old relics” (*sensu* Knutsson 2006, 177) from the Kongemose area of the site. Karsten and Knarrström (2001; 2003) have argued for the active implementation of handle cores during the Ertebølle phase of the Mesolithic, based on metric differences relating to core height between Ertebølle and Kongemose assemblages. Furthermore, Karsten and Knarrström (*ibid.*) argue that the cores from the Ertebølle contexts differ from the Kongemose cores in that the former have lower core fronts than the latter. However, this argument is based on an unbalanced number of cores from the two areas of the site (27 from the Ertebølle contexts and around 300 from the Kongemose contexts), which makes the statement less statistically reliable.

5.4.2.3 Rönneholm 6

The Rönneholm site complex is in Central Scania, in the southernmost part of Sweden. The complex has been excavated in several campaigns in 1995, 1997 and 1998 (Sjöström 2004). The sites in this complex were originally situated next to a lake, which has since then dried up. Today, the area consists of a peat bog with relatively good preservation conditions. The large bog contains multiple Mesolithic sites, several of which contain handle cores and related blade materials (Sjöström 2004).

One of these sites, Rönneholm 6, consists of an archaeological layer that contains the remains of a structure that has been interpreted as a hut (Fig. 41). The hut is visible both from the wooden piles located in a semi-circle around an area of burnt flint (interpreted as a hearth) and from the distribution of finds, which also indicates the existence of walls around parts of the structure (Sjöström 2004, 8).

Over 12,500 finds were recovered from the site, most of them made of flint. The assemblage consists of flakes, microflakes and other fragments, followed by blades and microblades. Larger blades were found on site, but the absence of larger cores, or related debitage, indicates that the larger blades were brought in from somewhere else. Furthermore, the assemblage contains multiple exam-

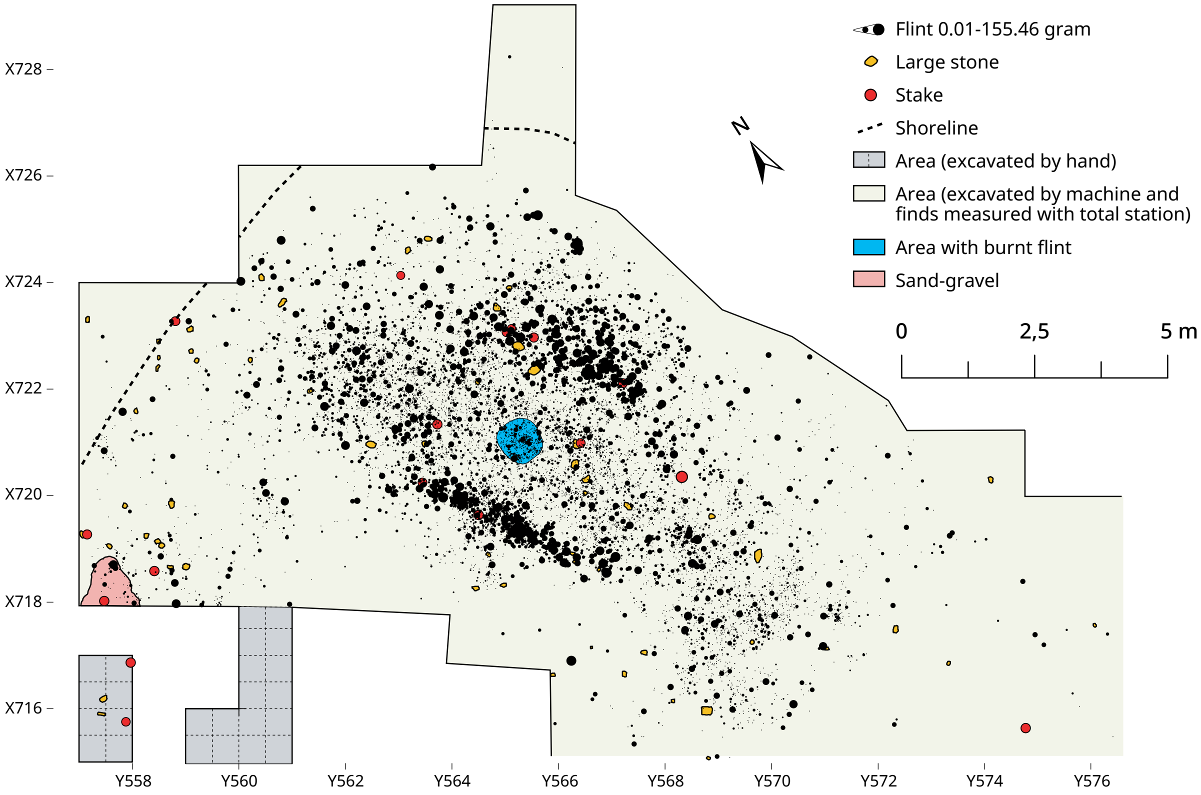


Figure 41. Find distribution and features around the hut at Rönneholm 6 (after Sjöström 2004).

ples of large blade fragments which were broken without the use of microburin technique (Sjöström 2004, 13-15). These fragments may have been used as small knives (*firkantkniv* – see Vang Petersen 2014, 66-67). A large amount of microblades, along with handle core finds, shows a clear focus on the production of small blades within the hut. The refittings of these assemblages have shown two possible concentrations within the hut, which might represent the knapping locations of two individuals (Sjöström 2004, 15).

Rönneholm 6 seems to be a short-term site dating to the end of the Kongemose period (Vedbaek phase), as indicated by typology (presence of transverse arrowheads) and radiocarbon dates. Three dates, two from wooden piles making up the hut structure as well as one from a hazelnut shell found in the central hearth of the hut, date the site to ca. 5700-5400 cal BCE (2 sigma range) (Sjöström 2004, 15).

Source critical aspects relating to the data: Few source critical aspects relate to this assemblage since it comes from a clearly limited context, both temporally and spatially. The materials also support the production of handle cores and related blades within this context.

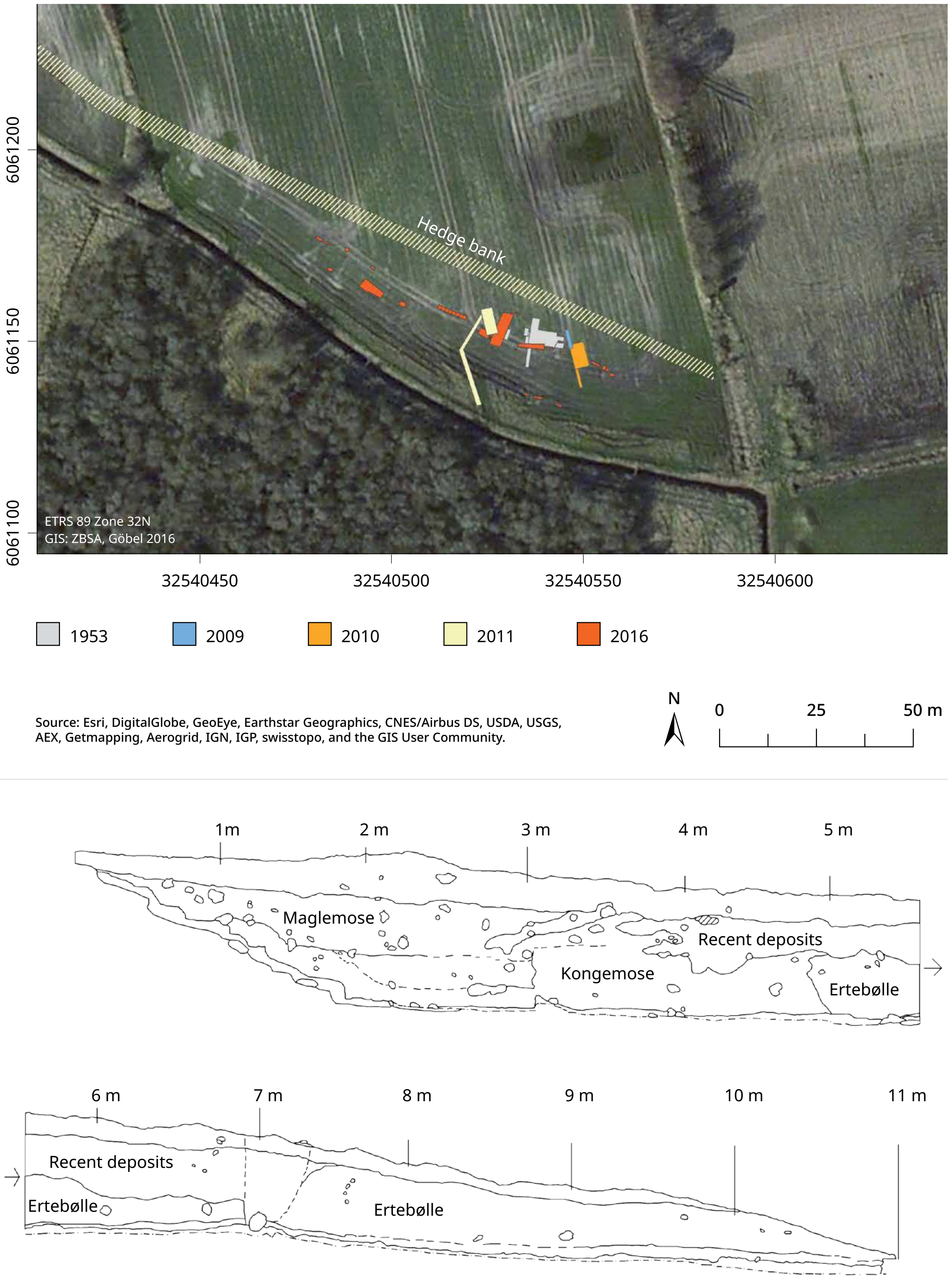
5.4.3 Focus area 2b – Northern Germany

5.4.3.1 Satrup LA 2

The site is located on the shore of a prehistoric lake in Northeastern Schleswig-Holstein, in Northern Germany. Today the area makes up the outer edge of the Satrupholmer Moor peat bog (Feulner 2010; Briel and Hartz 2020). The site has been subject to multiple excavation campaigns, initially in 1947 and then continuously during the next 10 years (Schwabedissen 1957/1958, as referenced by Briel and Hartz 2020). Several decades later, the site was revisited, first in 2008 for a small-scale research excavation (Feulner 2010), only to be resumed in a larger scale in 2010 and 2011 (Hartz 2016). Lastly, the site underwent rescue excavations in 2016 after the discovery that the site had been disturbed by unauthorised nature conservation activities (Briel 2016; Briel and Hartz 2020).

Several distinct cultural layers have been found relating to the Kongemose and Ertebølle periods, as based on the typology of the materials from each layer (Fig. 42; Briel 2016; Hartz 2016). Although the lowermost layer is likely to relate to a settlement phase during the Kongemose period, there is still a possibility that it could represent the Late Maglemose period (Briel and Hartz 2020). It is in this layer that handle cores and small blades were recovered.

The taphonomic conditions on the site are complicated due to several environmental factors. The body of the bog mainly consists of degraded fen, which is not a good environment for the preservation of bones. Nonetheless, bone artefacts, in seemingly well-preserved conditions, have been found. Additionally, soil analysis done in 2016 indicated high levels of chalk in the bog, which, along with a thick peat cover, have the potential to provide good preservation conditions for osseous materials (Briel 2016). The reason for the high levels of chalk is most likely the surrounding hills, made up of calcareous boulder clay (Briel and Hartz 2020). Although the bones from the site appear to be in good condition, low levels of collagen in them have prohibited successful radiocarbon dating results. Nonetheless, two samples with very low amounts of collagen were (unreliably) dated to ca. 6200-5700 cal BCE (Hartz 2016, 182). Because of the previous unsuccessful attempts to date the site, another try was made to date samples from it



ETRS 89 Zone 32N
GIS: ZBSA, Göbel 2016

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

Figure 42. Overview map of excavation campaigns at Satrup LA 2 (top – after Briel 2016) and stratigraphy from the excavations in 2016 (bottom – after Briel *et al.* 2018).

under the scope of this project. However, these attempts resulted in the same results of low collagen levels, which did not allow for reliable dating.

Activities on the site included meat processing and food consumption as seen by the remains of animal bones. Species present in the assemblage included wild boar, aurochs, elk, red deer and roe deer. Smaller amounts of other species were also found, such as wolf, fox, otter, badger, hedgehog, fish (mainly sturgeon) and wild horse. The addition of dog teeth further strengthens the idea of the site having been used in relation to hunting practices (Briel and Hartz 2020).

In the Kongemose layer, various osseous materials were found, including tools such as T-shaped antler axes/adzes and chisels. The materials also exhibit numerous flints, including blade cores (incl. handle cores), microliths (incl. trapezes, triangles, transverse arrowheads), blades and microblades, flake- and core axes, borers, burins, scrapers and debitage in the form of fragments, flakes, microblades, blades, *etc.* (Feulner 2010; Hartz 2016; Briel 2016; Briel and Hartz 2020). The Ertebølle layer contained flint, bone and ceramic fragments that are typical of the Ertebølle period (Briel 2016).

Source critical aspects relating to the data: As already mentioned, the preservation conditions have led to several failed attempts to date the organic remains from the site, thus the chronology is solely based on the technology and typology of the finds. Furthermore, the exact perimeters of the site are not established, therefore the assemblages collected during the different campaigns could relate to several sites or short-term visits. Furthermore, the assemblage contains only a few handle core finds, although more than 300 blades were found, making a comprehensive technological comparison difficult.

5.4.3.2 Dreggers LA 3

The site is located in Eastern Schleswig-Holstein in Northern Germany. The materials from the site were collected during surface surveys during the 1960s, -70s and -80s by P. Nierling (oral communication, Sönke Hartz 2017). The site is not excavated, which leads to a lack of information relating to the contexts of the finds and the site chronology. The large number of lithic finds might have been implemented on several smaller sites within the area, or were accumulated over a long period of time. The assemblage is extensive, containing several thousand flint finds. The find types include various blanks and fragments, such as flakes, blades, microblades and cores (incl. many handle cores), as well as artefact types such as retouched blanks, core/flake axes, scrapers, and burins. The many microliths include types such as trapezes, triangles and backed blades.

Based on the typology of the flints, the assemblage has been interpreted as dating to Late Maglemose/Kongemose periods in general. A small number of finds also relate to the Neolithic and the Bronze Age and likely reflect later activities in the area.

Source critical aspects relating to the data: Besides the already mentioned issues regarding the finds being collected via surface collection, the data was also recorded with a slightly different recording system than the other datasets. The reason for this is that the assemblage was recorded as part of a preliminary study of the handle core concept in Schleswig-Holstein (Söderlind 2018). This meant that some, more recently added attributes, could not be recorded or were recorded based on photographs, which are generally less reliable than studies of finds in person. Additionally, the mixed character of the materials from the palimpsest site also meant that blades were not recorded, since it cannot be excluded that the relevant artefacts were produced from a variety of core types.

5.4.3.3 Owschlag LA 183

The site is located in Central Schleswig-Holstein in Northern Germany. The site was excavated in 1970 by Joachim Kühl. It is located on the northern bank of the Sorge River, a tributary of the Eider, in a dune landscape where many other Late Mesolithic sites are located. Only a short excavation report exists (Bokelmann 1971). The assemblage is generally small, but it nonetheless contains scrapers, burins, handle cores and handle core blades. Additionally, microlith types include simple points, trapezes and narrow triangles. The artefact typology implies a chronology relating to the Middle and the Late Mesolithic (*ibid.*).

Source critical aspects relating to the data: Although the site is excavated and spatially limited, lacking dates and the small assemblage, especially related to handle core finds, limit the interpretive and comparative value of the data.

5.4.4 Focus area 3 – Southeastern Norway

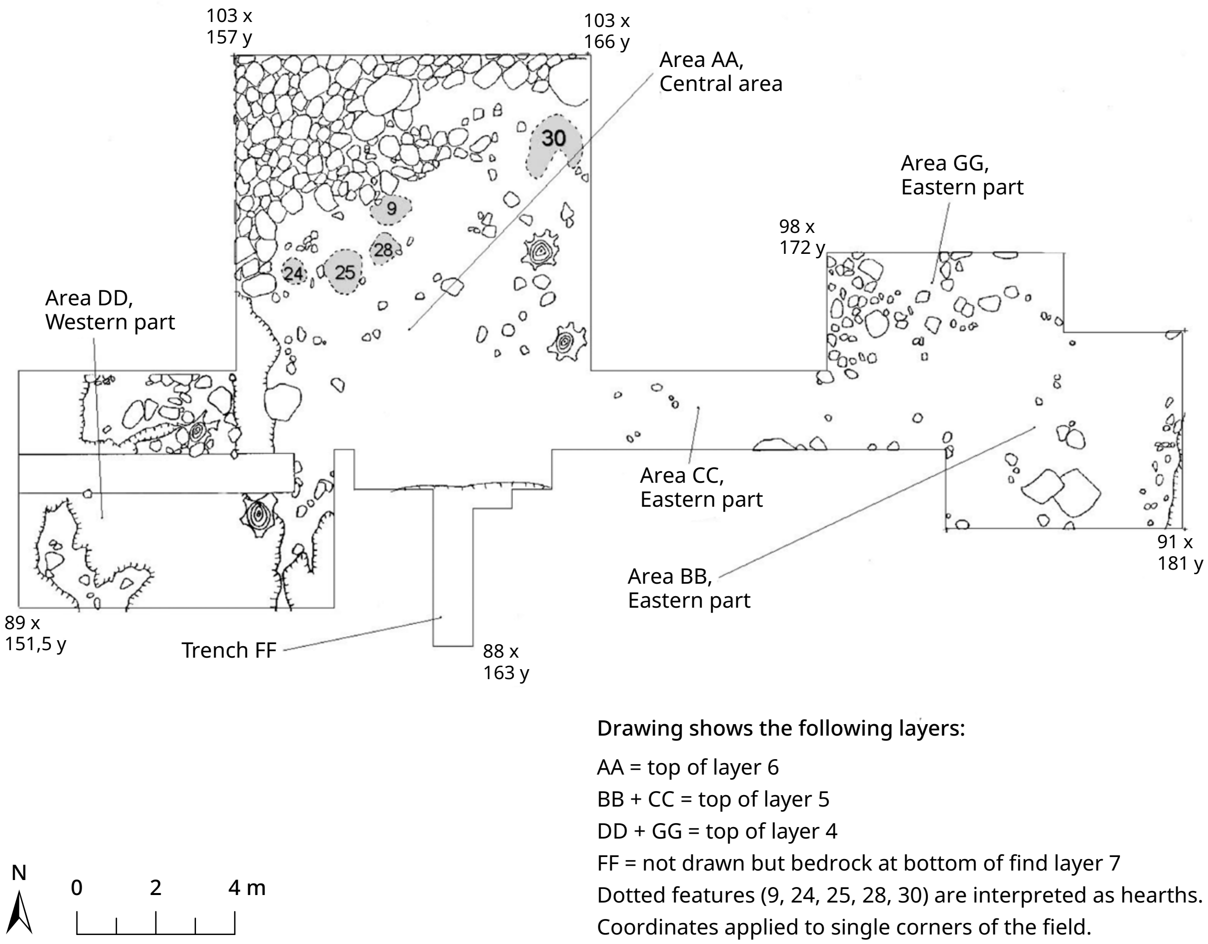
5.4.4.1 Halden excavations – Lokalitet 3

The site (C37499) is located near the village of Halden in Østfold County, Southeastern Norway. It was excavated in 1989 as a part of a research project aimed to investigate settlements from the Nøstvet phase of the Late Mesolithic in the area. However, the assemblage remained unstudied for almost two decades prior to analysis and publication by Melvold (2006).

The site is situated on sandy soils with (ca. 70 cm) thick cultural layers and multiple features (Fig. 43). Various remains of structures were present, mainly in the form of hearths and find concentrations, but possible discard/waste piles were also found. The presence of these types of features have led to the interpretation that the site was used during longer periods of time or repeatedly (Melvold 2006, 27, 89-94). Activities on the site included the production of lithic blanks and tools, stone axes and food preparation (*ibid.*, 56, 74, 87-88).

The lithic assemblage is large, containing almost 50,000 flint finds, and variation is seen in both raw materials and the artefact spectrum. Raw materials are represented by a clear dominance of flint, followed by quartz, undefined rock types (grouped under the term *bergart*), sand stone, diabase, quartzite, rock crystal, smoky quartz, and milky quartz (Melvold 2006, 31). The flint assemblage is largely made up of debitage in the form of flakes, blades, fragments, microflakes and different types of cores (bipolar, handle cores, single platform cores and irregular). The retouched tools include points, borers, scrapers and knives along with retouched flakes and blades (*ibid.*, 32). The bone assemblage consists of almost 13,000 bone fragments. Most of them are burnt, undetermined, animal bone fragments, which have been interpreted as representing waste from food preparation. Only nine bone fragments might represent artefacts, including several fragments of slotted bone points, needles and fishing hooks (*ibid.*, 37).

Six radiocarbon samples from the site fall within the Mesolithic period between 7000 and 5500 cal BCE, possibly with the main usage phase around 6500-6000 cal BCE. At that time, the site was located near the local shoreline according to the shore displacement curves (Melvold 2006, 41).



Drawing shows the following layers:

AA = top of layer 6
BB + CC = top of layer 5
DD + GG = top of layer 4
FF = not drawn but bedrock at bottom of find layer 7
Dotted features (9, 24, 25, 28, 30) are interpreted as hearths.
Coordinates applied to single corners of the field.

Figure 43. Overview map of Lokalitet 3 with different parts and features (after Melvold 2006, fig. 10).

Source critical aspects relating to the data: The archaeological materials from the site were accumulated during a longer time span, as based on the substantial cultural layers and scattered radiocarbon dates. Because of the longer site chronology, the finds are heterogenous in character, which affects the technological interpretations. For that reason, various core types were found on the site, which means that the blade assemblage cannot be clearly related to handle cores. Blades were thus not recorded from the site.

5.4.4.2 Krøgenes D2

The site (C59689, C60093) is located in Aust-Agder County, Southern Norway. It was discovered in 2013 and excavated in several campaigns from 2013-2016 (Fig. 44, Mansrud *et al.* 2018). The site's location results in a variety of taphonomic environments, ranging from wet/boggy soils in the southern part to more sandy/silty conditions in the north. Its location on the shore of a prehistoric lake, however, meant that it was likely a strategic place for water-based travel (Mansrud *et al.* 2018, 281-285). The site is interpreted as being repeatedly revisited, for shorter or longer periods of time.

The assemblage from the site consists exclusively of lithics, mainly in the form of flint (47.2%). Most of the flint material is made up of debitage and blanks such as flakes, blades/microblades and cores. The further worked artefacts are few in number but include retouched flakes and blades as well as two points,

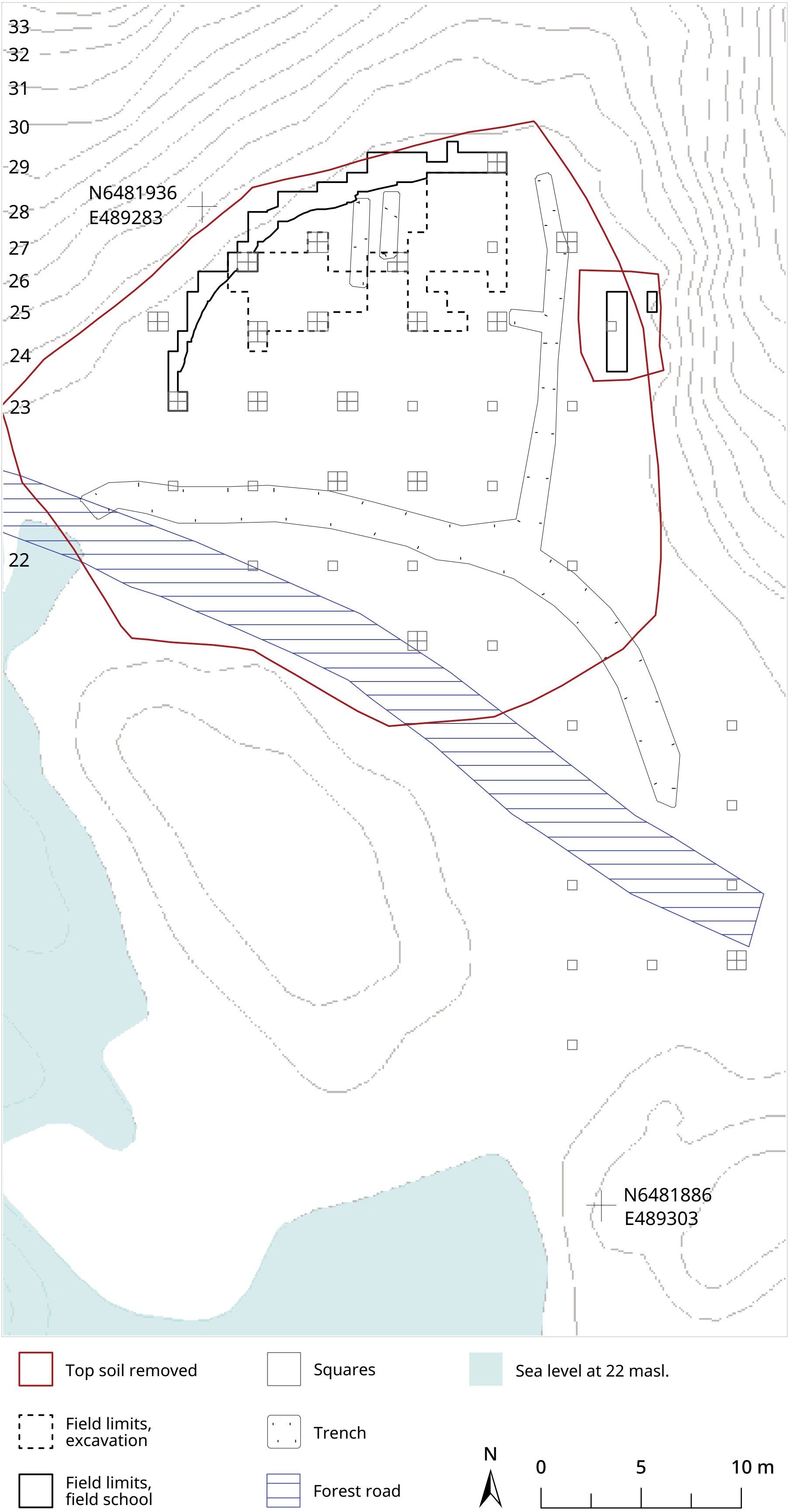


Figure 44. Overview map of Krøgenes D2 (after Mansrud *et al.* 2018).

namely a transverse arrowhead and a single-edged point (Norw.: *enegget spiss*). The core assemblage mainly includes conical cores, but handle cores are also present (Mansrud *et al.* 2018, 289-290).

Additional raw materials include undetermined rock (grouped under the term *bergart* 44.3%), quartz (8.1%) and a very small amount of rock crystal (0.2%) and quartzite (<0.1%). *Bergart* was used to produce axes (Nøstvet type), adzes and chisels. The rock crystal assemblage consisted of fragments, flakes, cores and microblades. Quartz is represented by flakes and fragments. The typology and technology of the artefacts and shoreline displacement indicate that the site was used during the Late Mesolithic (Norwegian chronology), sometime around 5300-5000 BCE (*ibid.* 2018, 289-290). This is further supported by the radiocarbon dates from the site (*ibid.* 2018, 302).

The core assemblage on Krøgenes D2 stands out compared to other contemporaneous sites in the area, which are commonly dominated by handle cores. Contrary to this, the Krøgenes site mainly contained conical cores and related blade production (according to Eigeland 2018). However, small, single-fronted cores, referred to in the publication as atypical handle cores, were also found on site (Mansrud *et al.* 2018, 304). These findings have been suggested to indicate a later shift from conical cores to handle cores in southernmost Norway (*ibid.*, 303).

Source critical aspects relating to the data: The site was used repeatedly, but only during a period of ca. 300 years. This means that, although the assemblage does not represent one short-term event, it also does not have an excessive settlement chronology. The presence of both conical cores and handle cores in the assemblage leads to less reliability regarding the blades from the site.

The report mentions some source critical aspects related to the site and excavations, for instance, variations in the sediment layers due to natural disturbances as well as later anthropogenic activities on the site. Additionally, the wet site has been drained in modern times. Soil has also been added to a part of the site during road constructions that stretch from east to west through the site. These activities also destroyed the southern part of the site. Furthermore, the radiocarbon dates suggest later activities on the site, *e.g.* during the Pre-Roman Iron Age (Mansrud *et al.* 2018, 285).

5.4.4.3 Stene terrasse

Stene terrasse (C55557, C56207, C53781) is located on the eastern terraced bank of the Rena River, in Hedmark County, Eastern Norway. The site was found in 2001 and excavated in 2006 and 2007 (Damlien 2010c). The site is located in a mixed forest vegetation environment with pebble- and boulder-rich sandy podzol soil (*ibid.*, 276).

The features on site consist of two cooking pits and a hut-structure with a hearth. The lithic assemblage amounts to ca. 4200 finds and consists of different, local, regional and exotic raw materials, including quartzites (81.5%), flint (9.4%), jasper (8.8%) and rock crystal (0.3%) (*ibid.*, 283). The flint assemblage mainly consists of debitage in the form of flakes and microflakes along with smaller numbers of microblades, blades and cores (conical, sub-conical and handle core types). The formal flint tools include flakes with retouch, microblades with retouch, scrapers, two microliths (oblique triangles) and a borer. The jasper material has a similar debitage pattern as the flint but with a larger number of blades, microblades and cores (mainly bipolar cores). Formal tools include scrapers, flakes with retouch,

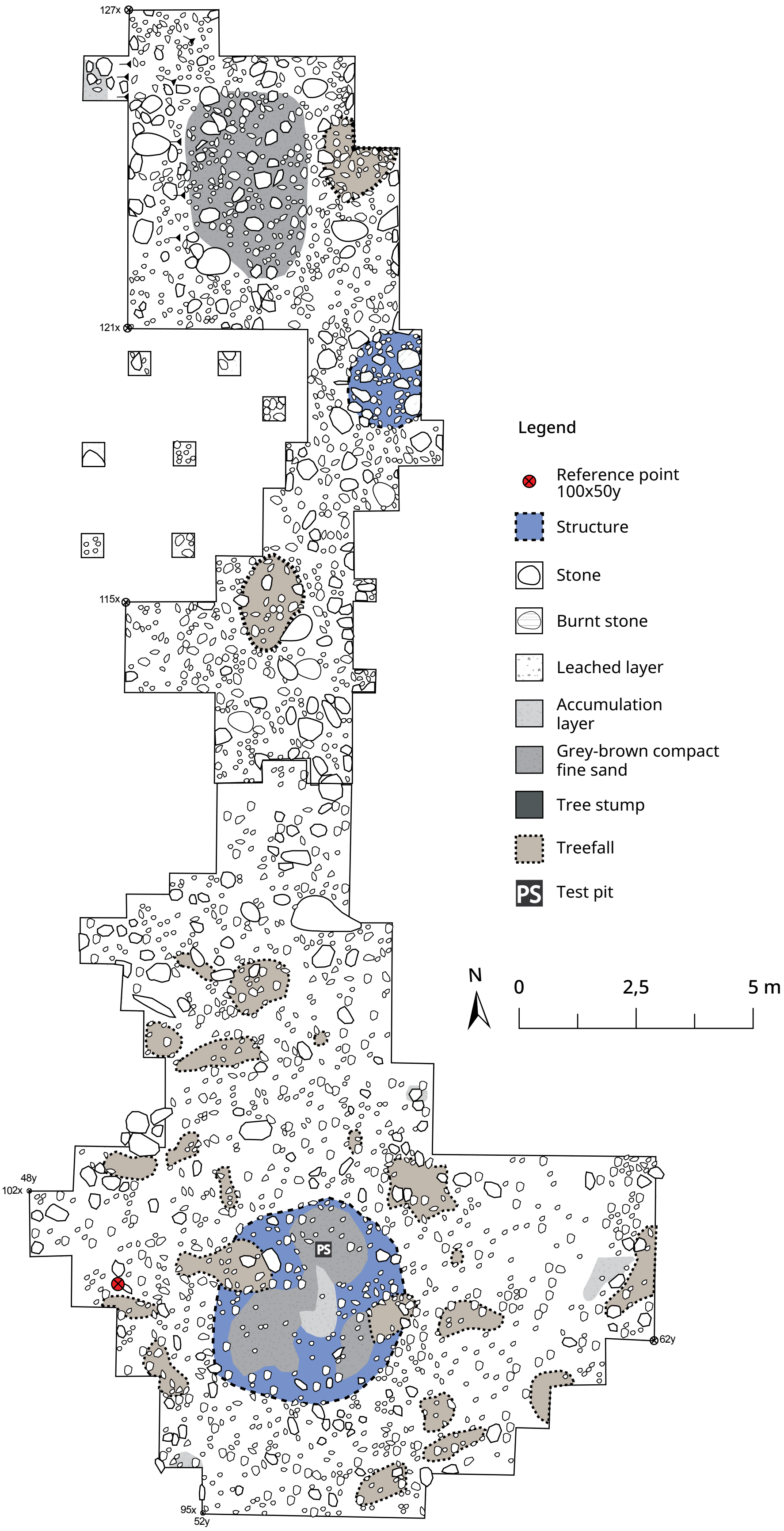


Figure 45. Overview map of Stene terrasse (after Damlien 2010c).

as well as one single microlith (oblique triangle). The quartzite assemblage contains the same type of debitage as the previously mentioned raw materials, with mainly flakes and fragments and smaller amounts of blades, microblades and cores (mainly single platform cores). Tools mostly consist of scrapers and flakes with retouch, as well as smaller amounts of burins, knifes, borers and blades with retouch (*ibid.*, 282-285).

Only two handle cores were found on the site. However, they were found alongside microblades in a clear find concentration in the southern part of the site (Fig. 45). The same area contains a concentration of burnt stones and bones, which has been interpreted as a hearth or cooking pit. Nearby remains have been interpreted as a hut structure (*ibid.*, 296). The bones from this area date to 3960-3800 cal BCE (TUa-6210: 5090±40 BP) and 4220-3990 cal BCE (TUa-6977: 5260±50 BP), while the charcoal has provided the dates 4210-3990 cal BCE (TUa-6975: 5245±35), 5310-5230 cal BCE (TUa-6382: 6335±50) as well as one Iron Age date. These dates fall within the Late Mesolithic Phase 4 (Damlien 2010c, 293; Reitan 2016).

Source critical aspects relating to the data: The lithic assemblage contains finds relating to both the conical core concept and the handle core concept, which leads to some uncertainty regarding the reliability of the blade data from the site, since it may reflect both concepts. The handle core finds are also few in numbers, but can be spatially related to a dated cooking pit on site.

Furthermore, the site was in an area that was used repeatedly throughout history. Tree falls were visible in the horizontal plan during excavation but were considered when interpreting the distribution patterns. Parts of the excavation area, especially in the southern part, were made up of very compact and hard layers that made excavations and sieving difficult at times. This also means that certain parts of the site remain unexcavated (Damlien 2010b, 276).

5.4.4.4 Stokke/Polland 8

The site (C59062) is located in Telemark County, Southern Norway, near the Oslo fjord. It was excavated in 2013 and 2014 (Fossum 2017). Two main activity areas have been found on the site (Fig. 46). They are both located in a forest area on sandy soils (brown earth soil), which resulted in poor preservation of organic remains. One structure was nonetheless found and has been interpreted as a hearth.

The lithic assemblage consists of 2600 finds. Raw materials are mainly represented by flint (83%), but smaller amounts of undetermined rock (grouped under the term *bergart* – 8.1%), rock crystal (2.8%), quartzite (5.7%), sandstone (0.3%) and quartz (<0.1%) were also found. The flint assemblage consists mainly of debitage such as flakes, fragments, microflakes, microblades and smaller numbers of cores and nodules. A few blanks were further worked, but the few that were found represent either retouched flakes, fragments or microblades (Fossum 2017, 439-42).

The two activity areas on the site (named A and B) have been interpreted as representing two short-term visits. The two areas also show some difference in character with more raw material variety on area B as well as a larger focus on axe production than on area A. Most of the assemblage from the site comes from area B, which also includes most of the handle core finds (Fossum 2017, 448).

Generally, activities on the site include the production and use of rock axes/adzes as well as the production and use of microblades along with the establish-

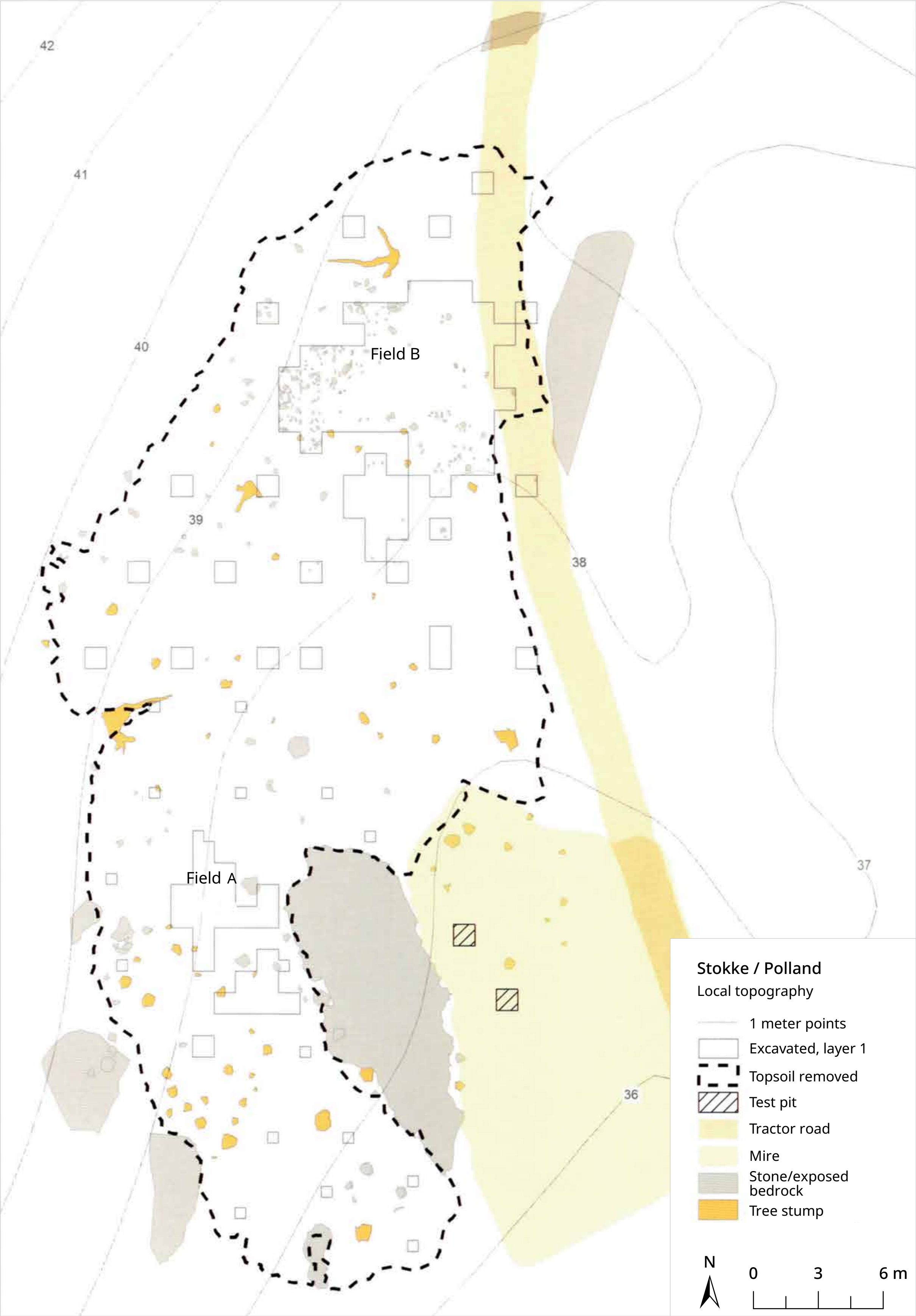


Figure 46. Overview map of Stokke/Polland 8 (after Fossum 2017).

ment of a hearth for food preparation. One radiocarbon sample of charcoal from the hearth resulted in a date of 5300-5060 cal BCE (Ua-51840: 6215±35), which falls within the Nøstvet phase of the Late Mesolithic. The technology and typology of the finds as well as the shoreline displacement curves support this chronology (*ibid.*, 452-453).

Source critical aspects relating to the data: The activity areas on the site are interpreted as short-term visits, which allow for a good chronological idea of the material. However, the short temporal scale of these visits also results in smaller assemblages, and fewer recorded finds, which limits the comparative value of the site.

Furthermore, some modern disturbances on the site were found during excavations, related to both modern digging and the burial of animal remains. These disturbances were especially common in the southern part of the site. The area may also have been drained which may have disturbed layers as well as affecting preservation conditions. Other activities on the site include the building of a road in the eastern part of the site, which limited the areas available for excavating. Lastly, patina on the flints has complicated the official recording of the finds (Fossum 2017, 439).

5.4.4.5 Vallermyrene 4

The site Vallermyrene 4 (C58360) is located in Telemark County, Southeastern Norway. It was discovered in 2011 and excavated in 2012 (Eigeland and Fossum 2014). Two main areas, A and B, make up the site, which used to be situated near the ancient shoreline of the Oslofjord (Fig. 47). The site is now located in an area previously covered by mixed leaf forest, with brown earth soil, which creates a poor soil environment for the preservation of organic remains (Eigeland and Fossum 2014).

The site has been interpreted as a specialised axe production site, based on the large amounts of axe production debitage. The lithic assemblage from the site is extensive with almost 50,000 finds, represented by raw materials such as undetermined rock (grouped under the term *bergart* – 71%) and flint (28.7%). Smaller amounts of rock crystal, quartz, quartzite, meta-rhyolite and sandstone were also found (Eigeland and Fossum 2014).

The flint debitage consists mainly of flakes, fragments and microflakes as well as smaller amounts of microblades, blades and core/core fragments. Handle cores are the most common core type and were mainly found on Area B. Formal tools include scrapers, borers, and various types of retouched flakes. The quartzite, rock crystal and quartz assemblages are much smaller in size and consist mainly of debitage in the form of flakes, fragments, microflakes, microblades and a few cores. The undetermined rock assemblage is made up of tools such as axes (mainly of *Nøstvet* type), polished axe fragments, ground stones, sandstone knives and hammer stones. Debitage consists exclusively of flakes, microflakes and other fragments (Eigeland and Fossum 2014).

Sites in the area of the Oslofjord can be confidently dated, based on their placement in meters above sea level, as sites that were generally located along the shorelines during the Mesolithic (Glørstad 2004). The local shore displacement curves show that the site must have been used after 5500 BCE. Additionally, the curves indicate that the two areas might have been used at slightly different times, with Area A dating to ca. 5400-5300 BCE and Area B to ca. 5200-5100 BCE. The typo-chronology of the finds from both areas indicates a placement within the Nøstvet phase (6350-4650 BCE), as based on the presence of Nøstvet axes, blade production from handle cores, ground stones and sandstone knives (Eigeland

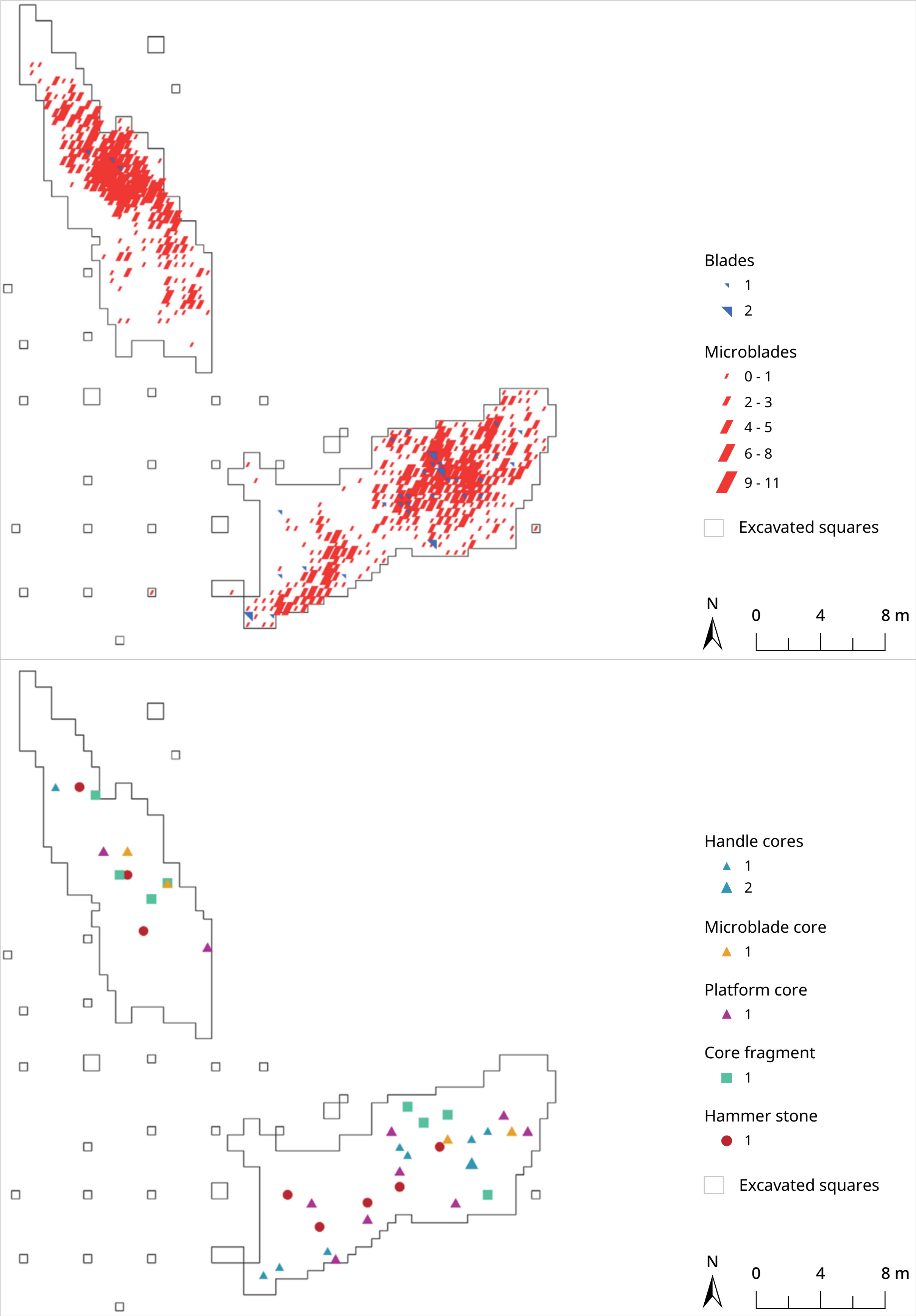


Figure 47. Overview map of Vallermyrene 4 with distribution of blades (top) and cores (bottom) (after Eigeland and Fossum 2014).

and Fossum 2014; Reitan 2016). The shoreline displacement curve, along with the typo-chronology, indicates that the whole site was in use sometime in the later stages of the Nøstvet phase, around 5400-4600 BCE (Eigeland and Fossum 2014). This is also supported by the results of four radiocarbon samples from the site. Two samples represent pine fragments from a pit on Area B (Ua-45172: 5299-5030 cal BCE (6498±50 BP) and Ua-45171: 5205-4841 cal BCE (6381±37 BP)), while two samples consist of burnt bone found in the cultural layer that covers Area A (Ua-45170: 5473-5225 cal BCE (6067±41 BP) and Ua-45169: 5552-5331 cal BCE (6197±40 BP)) (*ibid.*). This falls within the Nøstvet period in the Late Mesolithic (cf. Norwegian chronology in Reitan 2016).

Source critical aspects relating to the data: The extensive assemblage indicates that the site was used for an extended amount of time, or repeatedly over time. This provides a less technologically homogenous assemblage. Furthermore, later disturbances of the site include the instalment of an electrical mast within the excavation area. This destroyed several parts of the site and might have disturbed the stratigraphy. Additionally, a railway track occupies the eastern part of the site and hindered investigations in that area. South of the site, there is a steep area in the terrain, where some finds seem to have fallen down during erosion (Eigeland and Fossum 2014, 37).

5.4.5 Focus area 4 – Lithuania

5.4.5.1 Dubiciai 1 (Salaitė)

The site is located on sandy soils in the Varėna district in Southeastern Lithuania. Several sites were found on Dubiciai Island in the prehistoric Pelesa Lake. The site was discovered at the end of 19th century and excavated in the 20th century (Rimantienė 1974, 32). The site is an open-air sandy type site with mixed material from several chronological stages. According to the available material, the site was attributed to the Neolithic, however, some lithics (microliths, cores) indicate that it should also belong to the Mesolithic (Kulturos vertybiu registras: https://kvr.kpd.lt/#/static-heritage-detail/bfb3bad7-4e4a-45ff-828c-2ab011139ee0, last accessed: 2.6.2020).

Source critical aspects relating to the data: The site is a palimpsest and finds were only collected on the surface. The soil is sandy, which makes for poor preservation conditions. The assemblage includes a variety of materials, mainly from the Neolithic. Thus, little can be said about the chronology of the site, or technological change over time. One handle core from the site was nonetheless studied to contribute to a general idea about the concept in Lithuania, along with the other cores from the focus area.

5.4.5.2 Dusia 8

The site is located on the north-western part of Lake Dusia, in the Lazdijai district of Southern Lithuania. Excavations were conducted in 1989-1995 from which a total of 501 m^2 were excavated. The soils are sandy with certain areas covered by peat and clay, creating good preservation conditions in parts of the site (Juodagalvis 1992).

Finds imply that the site is a palimpsest used during a long timespan, starting in the Mesolithic. However, pottery and polished stone tools indicate further activities in the Neolithic and the Bronze Age (Juodagalvis 2010). Although the material on the site is mixed, the Mesolithic artefact spectrum can be distinguished by its technology. The assemblage includes long and narrow blades, conical cores, various types of trapezes and lanceolates (Juodagalvis 1999).

Source critical aspects relating to the data: The site is mixed and therefore does not give a clear idea of the handle core concept at a given time. Radiocarbon dates are lacking, which leads to a poor understanding of the site chronology and technological change over time. One handle core from the site was nonetheless studied to contribute to a general idea about the concept in Lithuania, along with the other cores from the focus area.

5.4.5.3 Gribasa 4

The site is located on the shore of former Duba Lake, in the very south-east of present time Lithuania. It was discovered in 1998 and excavated in 1999-2000 (Grinevičiūtė and Ostrauskas 2000). The sandy soils, on which the site is situated, have led to poor preservation of organic remains. The lithic and ceramic assemblages from the site, however, indicate a long chronology, spanning from the Final Palaeolithic to the Late Neolithic (Rimkus 2018).

Circa 3790 worked flints and 658 ceramic finds were recovered. Many of them have been interpreted as belonging to the Late Mesolithic Neman technocomplex (Grinevičiūtė 2002). A possible existence of Kongemose relations on the site has been suggested, based on the presence of three rhombic microliths (Rimkus 2018). Other microliths found in the assemblages include lancets, triangles and trapezes. Furthermore, the materials from the site also exhibit a large variety in the blade assemblage, with both irregular and very regular blades, which likely represent various knapping techniques, including pressure technique, from a variety of core types (recording notes, National Museum of Lithuania, 12.8.2019).

Source critical aspects relating to the data: The site is a palimpsest with activities during most of the Stone Age. Sandy soils provide poor preservation conditions. Thus, little can be said about the chronology of the site or technological change over time. One handle core from the site was nonetheless studied to contribute to a general idea about the concept in Lithuania, along with the other cores from the focus area.

5.4.5.4 Kabeliai 1

The site is located in the Varėna district of Southern Lithuania. Kabeliai 1 is located just north of the much more investigated and famous site Kabeliai 2 (cf. Ostrauskas 2002). The assemblage from Kabeliai 1 is very limited, consisting of few finds from a surface collection with some test pits. No excavations have been performed on the site.

Source critical aspects relating to the data: The site is a palimpsest and finds were only collected on the surface. The assemblage is limited in size, which makes for unreliable comparisons. One handle core from the site was nonetheless studied to contribute to a general idea about the concept in Lithuania, along with the other cores from the focus area.

5.4.5.5 Katra 1

The site is located on the right bank of the Katra River in southernmost Lithuania. An area of ca. 2000 m^2 was excavated in 1998-1999 (Girininkas 2000). The site's location on a sandy terrace provides no observable stratigraphy or organic remains.

The excavations led to the unearthing of hearths, storage pits and hut structures, as well as ca. 200,000 flint artefacts, 5,000 ceramic pieces and ca. 100 stone (undetermined rock) artefacts. This large palimpsest contains finds that relate, typologically and technologically, to various time periods, stretching form the Final Palaeolithic to the Early Bronze Age (Girininkas 2000; Rimkus 2018). The presence of one rhombic point could indicate relations to the Kongemose technocomplex (Rimkus 2018).

Source critical aspects relating to the data: The site is a palimpsest, which contains finds from throughout the Stone Age and the Bronze Age. Thus, little can be said about the chronology of the site, or technological change over time. Handle cores were nonetheless studied to get a general idea about the concept in this focus area.

5.4.5.6 Maksimonys 4

The site is located in the Varėna district of Southern Lithuania. The site was excavated in 1963 and later republished (Rimantienė 1971, 118-22). It is located on a river terrace of the Neman River on sandy soils, which provide poor preservation conditions. Nonetheless, some organic remains of hazelnuts and fish bone were found near a hearth structure (Koltsov 1989, 60).

Flint finds include single platform cores, scrapers, knives, retouched blanks (flakes and blades), microblades (retouched and not retouched), axes/adzes, *etc.* Kolstov (1989, 60) interprets the finds as relating to the Janislawice technocomplex. Rimantienė (1971, 118-22) instead argues for the site's relation to the Maglemose technocomplex. If there is a common heritage between the two technocomplexes, they might both have been correct. In summary, the assemblage from the site indicates a chronology stretching from the Late Palaeolithic/Early Mesolithic until the Neolithic.

Ceramics were also found in the assemblages from the site. Additional observations of the flint assemblages also highlighted the presence of blades of irregular and irregular/regular character. Few blades with high regularity could be found (recording notes, author).

Source critical aspects relating to the data: The site is a palimpsest. Thus, little can be said about the chronology of the site or technological change over time. Handle cores were nonetheless studied to get a general idea about the concept in this focus area.

5.4.5.7 Margiai 1 and 2

The sites are in the Varėna district of Southern Lithuania. Several sites were found on Margiai "Island", located in prehistoric Duba Lake, and have been excavated in several expeditions, *e.g.* in 1902, 1943 and 1999 (Ostrauskas 2000, 50-51; Šatavičius 2000, 67-69; 2016). Margiai 1 and 2 are two of these sites. Soils are sandy and the preservation conditions for organic remains are poor.

Circa 3200 flint finds were uncovered in the excavations. The flint is of a local variant and artefacts include, for instance, microliths (triangles, blades with abrupt and semi-abrupt edges, lanceolates, *etc.*), a borer and an axe. Ceramic finds include ca. 2300 fragments (Šatavičius 2000, 67-69). The chronology of the site seems to span from the Late Palaeolithic to the first half of the Neolithic and typological studies of the materials from the site indicate a connection to the Late Hamburgian/Bromme, Swiderian and Kunda technocomplexes (Šatavičius 2016).

Source critical aspects relating to the data: The site is a palimpsest with activities during most of the Stone Age. Sandy soils provide poor preservation conditions for organic remains. Thus, little can be said about the chronology of the site or technological change over time. Handle cores were nonetheless studied to get a general idea about the concept in this focus area.

5.4.5.8 Netiesai 1

The site lies in Southern Lithuania on the banks of the Nemunas River. The first surface finds from this area were collected in 1938. An area of 1315 m^2 was subsequently excavated in 1962-1963 by R. Rimantienė (1971, 85). Netiesai 1 is an open-air sandy type site, located on sandy sediments, with mixed archaeological materials. The earliest settlement stage has been assumed to relate to materials such as Late Palaeolithic opposite platform cores and Swiderian tanged points. The second phase relates to the Mesolithic, where microlithic technology is visible through the various types of inserts, lanceolates, trapezes and Pulli points, which is a long tanged and barbed point type (Rimantienė 1971, fig. 123). Finally, the last phase belongs to the Neolithic, as indicated by the presence of pottery, grounded stone and flint axes (Rimantienė 1974, 59).

Source critical aspects relating to the data: The site is a palimpsest with activities during most of the Stone Age. Sandy soils provide poor preservation conditions. The phases that make up the site chronology are based solely on typology. Thus, little can be said regarding the chronology of the site or technological change over time. Handle cores were nonetheless studied to get a general idea about the concept in this focus area.

5.4.5.9 Papiskes 4

The peat bog site is located on the banks of the Vokė River in Southeastern Lithuania. It was discovered and excavated in 1989 (Brazaitis 1990). Two thick cultural layers were discovered. The lower cultural layer contained thousands of flints, mainly in the form of debitage but also microliths (triangles, rhombic), knives, scrapers, cores and retouched blades. Additionally, ceramic and osseous materials were found. The assemblage indicates that the site should be considered a palimpsest, with finds typologically dating from the Mesolithic until the Bronze Age, or later (Brazaitis 2004).

Source critical aspects relating to the data: The site is a palimpsest. Little can be said about the chronology of the site or technological change over time. One handle core from the site was nonetheless studied to contribute to a general idea about the concept in Lithuania, along with the other cores from the focus area.

5.4.5.10 Varėna 2

The site is in the Varėna district in southern Lithuania. In 1999, an area of ca. 150 m^2 was excavated. The site is interpreted as a palimpsest, with finds that date, typologically, to a long time span stretching from the Late Palaeolithic to the

Early Neolithic. Finds have been accredited to Janislawice, Nemunas and Corded Ware technocomplexes (Grinevičiūtė and Ostrauskas 2000).

Source critical aspects relating to the data: The site is a palimpsest with mixed archaeological materials accumulated over a long time. Thus, little can be said about the chronology of the site or technological change over time. One handle core from the site was nonetheless studied to contribute to a general idea about the concept in Lithuania, along with the other cores from the focus area.

5.4.6 Sites beyond the focus areas

5.4.6.1 Grądy-Woniecko, Poland

The site is located ca. 2 km from the village with the same name on the bank of the Narew River in Eastern Poland. The city of Białystok is located ca. 60 km east of the site.

The site Grądy-Woniecko was discovered and initially excavated in 1974 (Burek 1974, 10-11; 1976, 472-74). Further excavations took place in 1978 (Kozłowski and Szymczak 1978, 12-13), 1997 (Szymczak 2006), 2005 (Józwiak 2005, as referenced in Wawrusiewicz *et al.* 2017) and 2016 (Wawrusiewicz *et al.* 2017). The site is situated in an active sand dune area, which makes for complex stratigraphies and mixed chronologies (Fig. 48; *ibid.*).

Materials from the site include ceramics (7648 fragments) and flint (10,620 fragments). Large parts of these assemblages were collected as surface finds, revealed as the sand dunes shift, while a smaller part was uncovered during excavations in the dunes. Despite the movement of the dunes and the related intermixing of contexts, some seemingly intact contexts have been found on the site. These include pits with human and animal bone fragments (interpreted as graves), other types of bone clusters and two deposits of flint artefacts. The latter is especially interesting as one of the flint deposits contained 17 cores and

Figure 48. Find scatter on the surface of the sand dune site Grądy-Woniecko from a visit to the site in 2019 (Photo: S. Söderlind).

preforms, some of which resemble handle cores. All the cores were made from erratic Baltic flint, locally found in the moraine. Another nearby flint deposit contained 7 microliths (Wawrusiewicz *et al.* 2017, 277).

Radiocarbon dates from the site have not been able to produce an absolute chronology of the site, but the typology of flint and ceramics indicates that the site was used during a long time period starting in the Sub-Neolithic (in the middle of the 5th millennium BCE), throughout the Neolithic and into the Bronze Age (Wawrusiewicz *et al.* 2017, 278-279).

Source critical aspects relating to the data: The character of the site with its mobile sand layers makes the understanding of contexts and site chronology difficult. The presence of ceramics also alludes to a longer chronology, which is not limited to the Mesolithic.

The presence of handle cores on the site is limited to one deposit. Additionally, blade production does not seem to have been a focused activity on the site (Wawrusiewicz *et al.* 2017, 278-279). These patterns indicate that the handle core concept was not implemented on the site in general. Perhaps the unique deposit of cores and preforms may have been produced and stored on the site, in preparation for being transported elsewhere. Alternatively, the deposit may have been brought into the site from somewhere else in the area but not yet used for blade production.

6 Results – Technology and chronology of the handle core concept

The results of the technological investigations of the handle core concept will be presented here and explored using statistical tests and multivariate analyses (6.1). Additionally, a handful of new radiocarbon dates from handle core contexts in the research area are presented to further an understanding of the chronology of the concept (6.2). A discussion of the results can be found in Chapter 7.

6.1 The handle core concept

The data will be presented in three forms in this chapter. Firstly, using descriptive univariate statistics as a way of reporting the findings in detail (6.1.1-6.1.2). Note that many of the assemblages are small, often under 30 specimens, which when displayed as percentages may suggest misleading trends. Nonetheless, the relative amounts will be discussed in the text for comparability reasons. The absolute numbers can instead be seen in the graphs. Secondly, the relationship between different attributes will be explored using multivariate statistics (6.1.3). Thirdly, the data will be used to establish a *chaîne opératoire* for the handle core concept for each focus area (6.1.4). The most relevant data, for answers to the research questions, will be presented here. However, all complete datasets can be found in Appendix I.

6.1.1 Regional comparisons

Data from the technological analyses of cores and blades were collected from five focus areas: the Upper Volga region in Western Russia (F1), Southern Sweden (F2a), Northern Germany (F2b), Southeastern Norway (F3) and Southern Lithuania (F4). A handful of cores from one Polish site, Grądy-Woniecko, will also be presented.

The data from each focus area is divided into two parts, one relating to attributes found on cores and one relating to the blades. The recorded data from the different focus areas, and sites within them, will be presented here, using descriptive statistics which is illustrated in graphs.

6.1.1.1 Focus area 1 – Western Russia

Platform design (KSFA) and platform use (KSFN)

The single-fronted cores from Russia most commonly have a single platform (92.6%). A small number of cores have a secondary platform, located on an opposing core side (7.4%). On all of these cores, the second platform was created and used successively after the initial platform was abandoned (Fig. 49).

Core front design (KAAN)

A large portion of the cores has one single core front (85.2%), while the rest (14.8%) has two core fronts situated on opposite sides of the platform (Fig. 50).

Handle core on flake (HCF)

The cores are commonly produced from a nodule (73.1%), although production from a flake is also represented in the assemblage (26.9%) (Fig. 51).

Core back (KR)

The backs of the cores are commonly prepared, showing flake negatives (82.6%), while the rest are unprepared, with cortex (17.4%) (Fig. 52).

Core side 1 (KS1) and core side 2 (KS2)

The core sides have similar attributes on KS1 and KS2. KS1 mainly consisted of flake negatives (40.7%), one large flake negative (25.9%) or a cortex (18.5%). Lateral edge preparation, found alongside flake negatives, was present on 14.8% of the cores. On KS2, flake negatives are also most common (53.8%), followed by an equal number of cores with one large flake negative (19.2%) and a cortex (19.2%). Lateral edge preparation found alongside flake negatives was present on 7.7% of the core sides (Fig. 53).

Platform morphology (PMORPH)

A large proportion of the cores has faceted platforms (86.2%) or partially faceted platforms (3.4%). The rest of the cores has smooth platforms (10.3%) (Fig. 54).

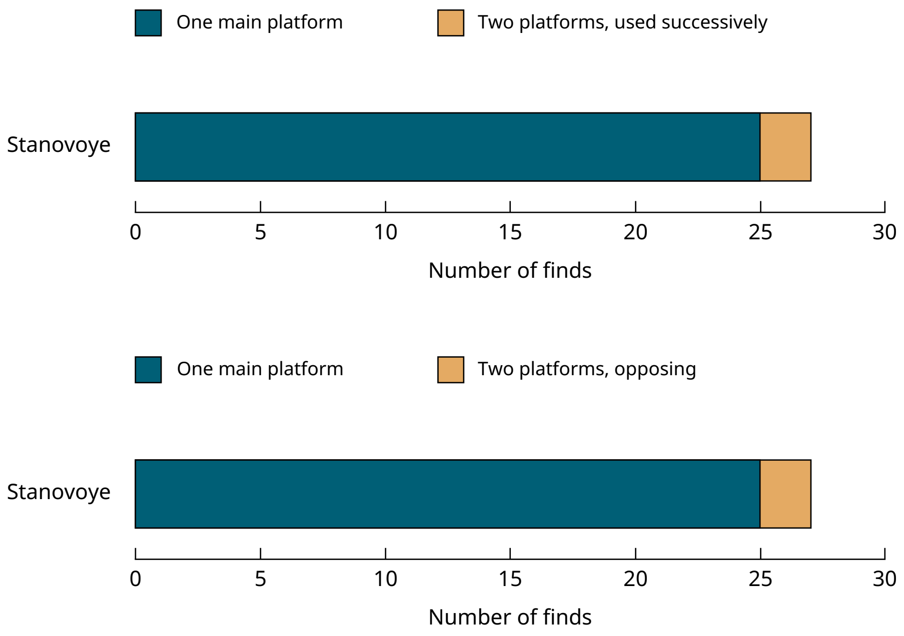


Figure 49. Platform design (KSFA, first bar graph) and platform use (KSFN, second bar graph) of recorded cores from Stanovoye 4.

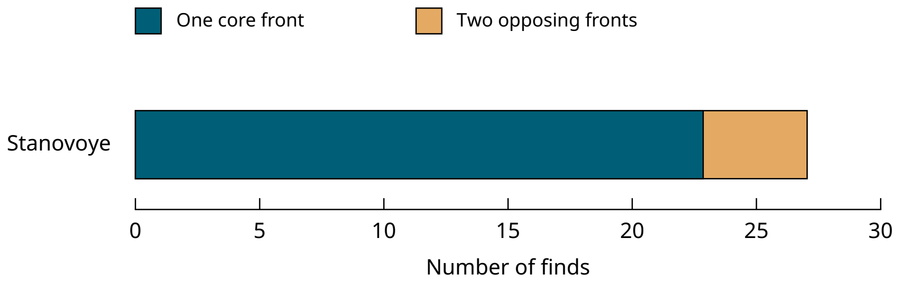


Figure 50. Core front design (KAAN) on recorded cores from Stanovoye 4.

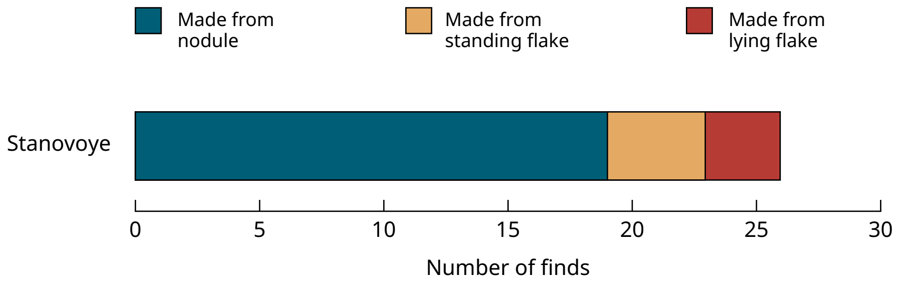


Figure 51. Handle core on flake (HCF) among recorded cores from Stanovoye 4.

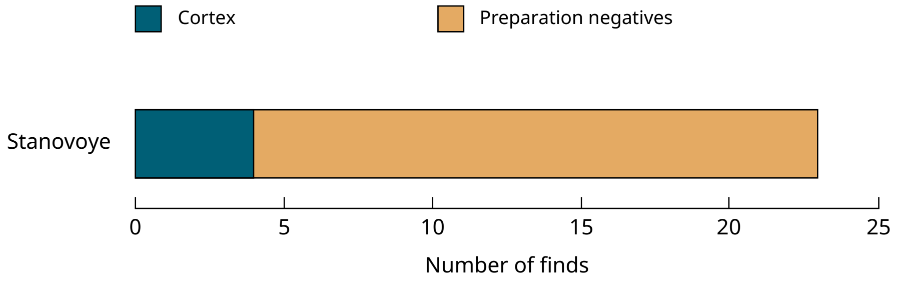


Figure 52. Core back (KR) on recorded cores from Stanovoye 4.

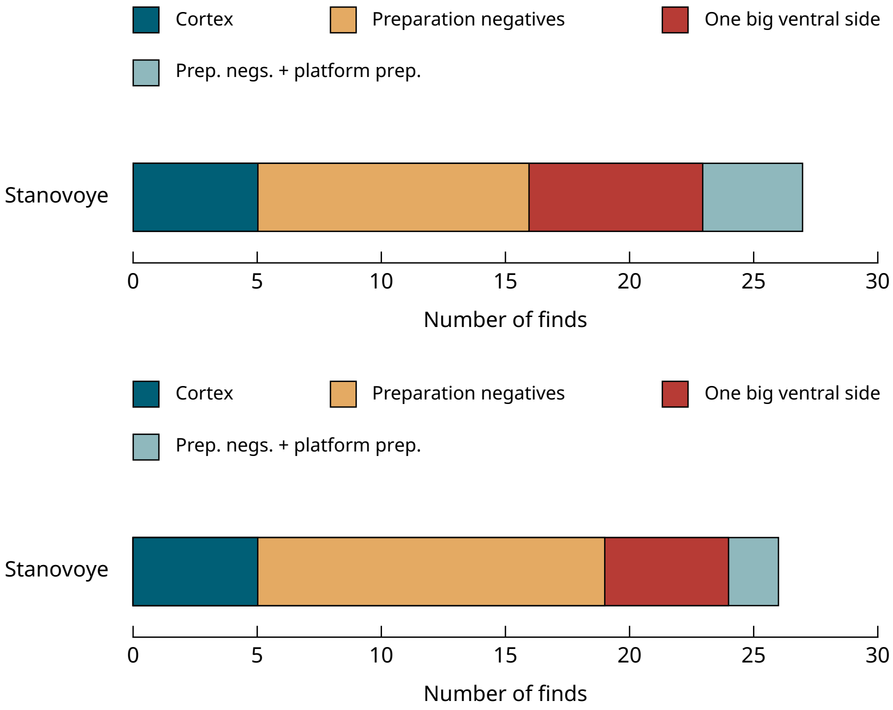


Figure 53. Core side 1 (KS 1, first bar graph) and core side 2 (KS 2, second bar graph) on recorded cores from Stanovoye 4.

Platform preparation dorsal (PPCD)

Core front preparation is mainly done by trimming (40.6%), followed by trimming on the platform, near the front (21.9%) and a combination of regular trimming and trimming on the platform, near the front (18.8%). Cores without any preparation (15.6%) are also present, as well as a single core that has both trimming and abrasion located on the core front (3.1%) (Fig. 55).

Exterior platform angle (EPANG)

The angle between the core front and the platform varies greatly within the assemblage, ranging from 55 degrees to 95 degrees. Almost equal proportions exist between cores with angles of 70 degrees (14.8%), 75 degrees (18.5%), 80 degrees (14.8%), 85 degrees (14.8%), 90 degrees (14.8%) and 95 degrees (11.1%). Smaller amounts of cores display angles around 55 degrees (7.4%) and 65 degrees (3.7%) (Fig. 56).

Core size (L, B and D)

The mean height of the cores is 28.43 mm. The mean width is 15.37 mm and the mean length is 28.97 mm (Table 34). The standard deviation (SD) is a measurement of variability, or spread, of the individual measurements from the mean. Basically, it is a good indicator for how much variety there is between the data points. A larger standard deviation indicates more variety from the mean. The standard deviations in this focus area indicate that core height (L) and length (D) are more varied than core width (B).

Summary for focus area 1

The single-fronted cores from Stanovoye 4 (representing focus area F1) commonly have a single platform, a single core front and are mainly made from nodules. They are most often rejuvenated through platform rejuvenation and show faceted

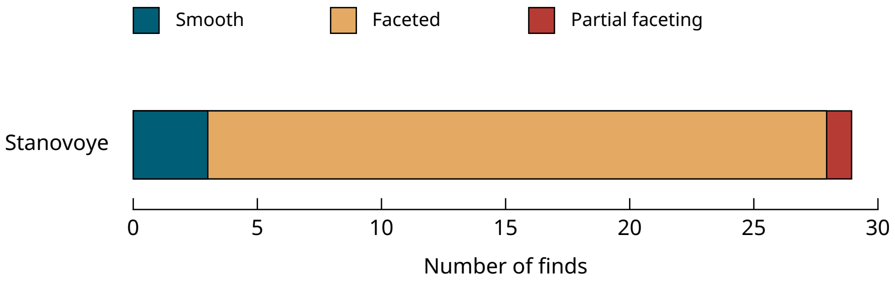


Figure 54. Platform morphology (PMORPH) on recorded cores from Stanovoye 4.

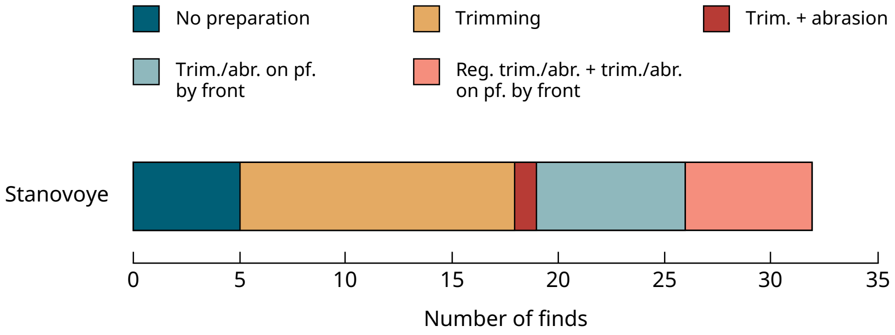


Figure 55. Platform preparation dorsal (PPCD) on recorded cores from Stanovoye 4.

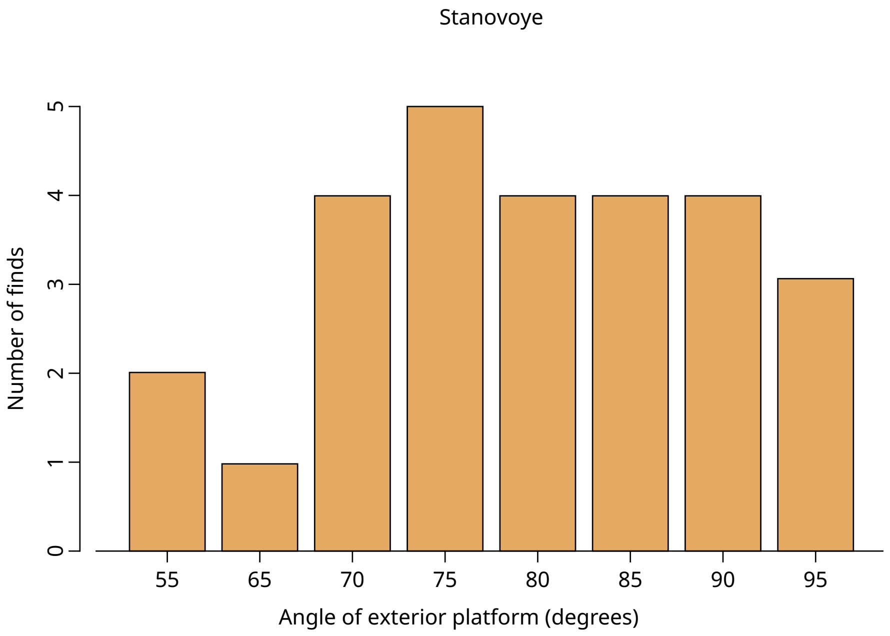


Figure 56. Exterior platform angle (EPANG) on recorded cores from Stanovoye 4.

Focus area 1 – Stanovoye 4								
	Min.	**1st Qu.**	**Median**	**Mean**	**3rd Qu.**	**Max.**	**SD**	**n**
Core height (L)	14.80	23.80	25.80	28.43	34.30	42.60	7.59509	27
Core width (B)	8.40	13.45	15.00	15.37	16.45	27.40	4.166609	27
Core length (D)	15.60	22.05	27.70	28.97	34.90	51.70	8.4517	27

Table 34. Core measurements (height, width and length) of cores from Stanovoye 4.

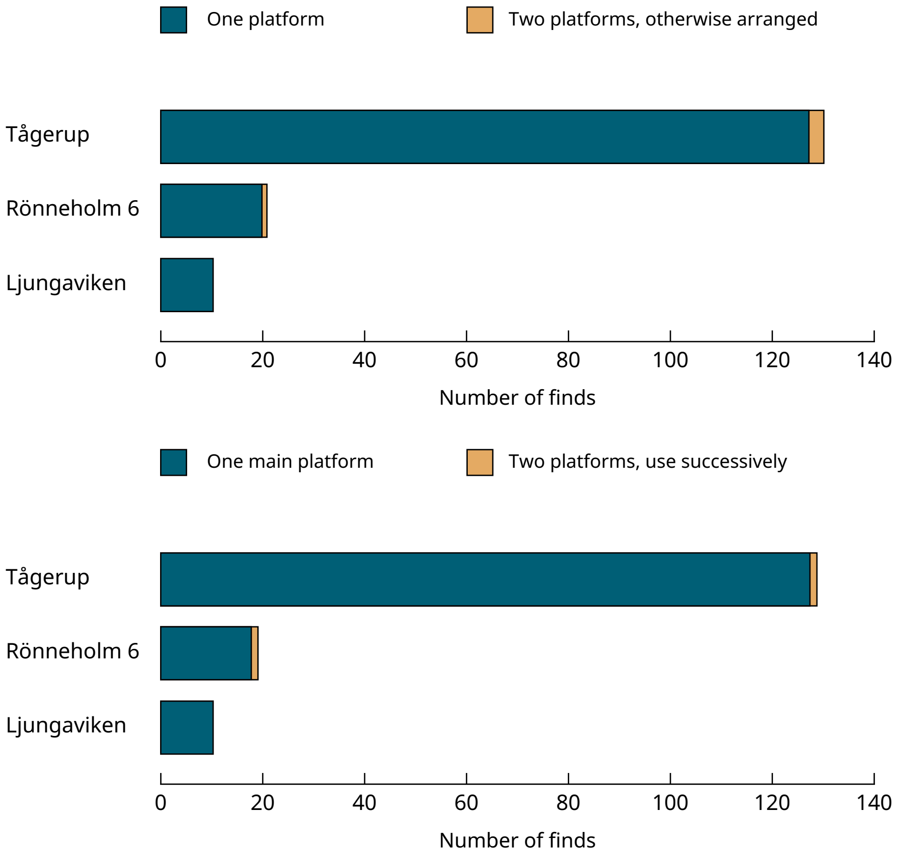


Figure 57. Platform design (KSFA, first bar graph) and platform use (KSFN, second bar graph) of recorded cores from focus area 2a, by site.

platforms. The back of a core is often shaped by striking away flakes, which is also common for the sides of the core. Additionally, the core sides often show one large flake negative or cortex. Side core preparation exists on a smaller part of the assemblage. Core front preparation often appears in the form of trimming. The angle between the core front and the platform is highly varied. Cores have an average size of less than 30 mm in length or height. Blades were not recorded from Stanovoye 4 and therefore little can be said about the methods and techniques involved in the blade production.

6.1.1.2 Focus area 2a – Southern Scandinavia

Platform design (KSFA) and platform use (KSFN)

Among the assemblages, most cores were produced with one platform. In the two larger assemblages (Tågerup and Rönneholm), there are also a few examples of cores that have a secondary platform, which was used subsequent to the first one (Fig. 57).

Core front design (KAAN)

Most cores in the area have one core front, but each assemblage also contains some examples of cores with an additional front. The presence of an additional front can be seen on 10% of cores from Ljungaviken, on 5.6% of cores from Rönneholm 6 and on 9.7% of cores from Tågerup.

The placement of the additional core front differs slightly on the different sites. In the Tågerup materials, there are cores with two core fronts placed on

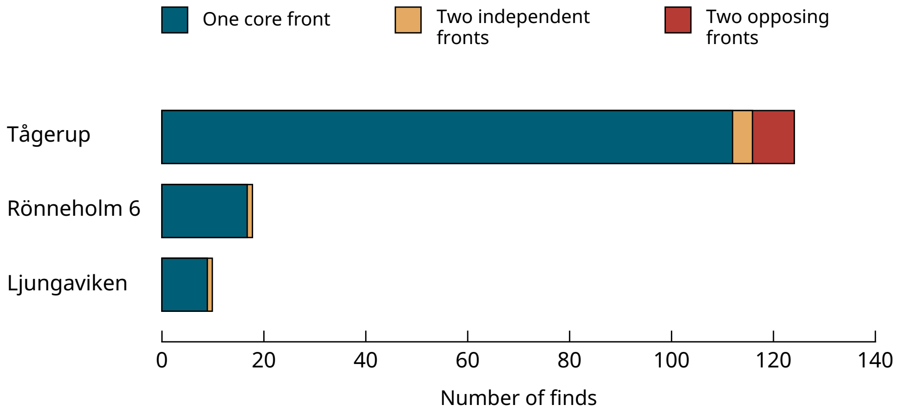


Figure 58. Core front design (KAAN) on recorded cores from focus area 2a, by site.

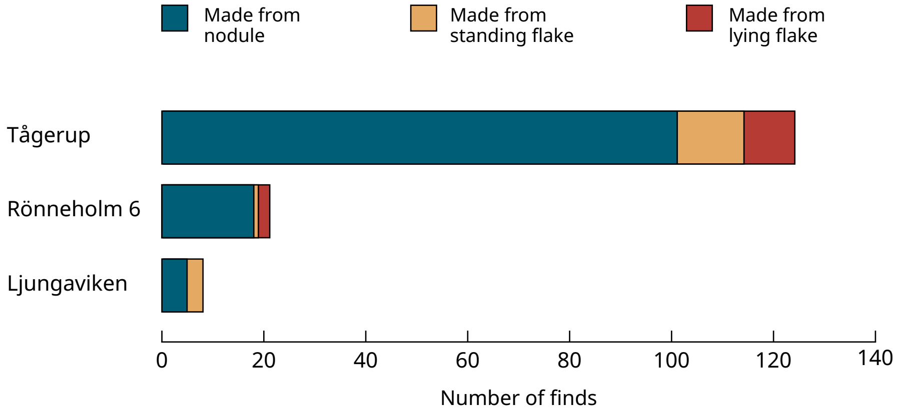


Figure 59. Handle core on flake (HCF) among recorded cores from focus area 2a, by site.

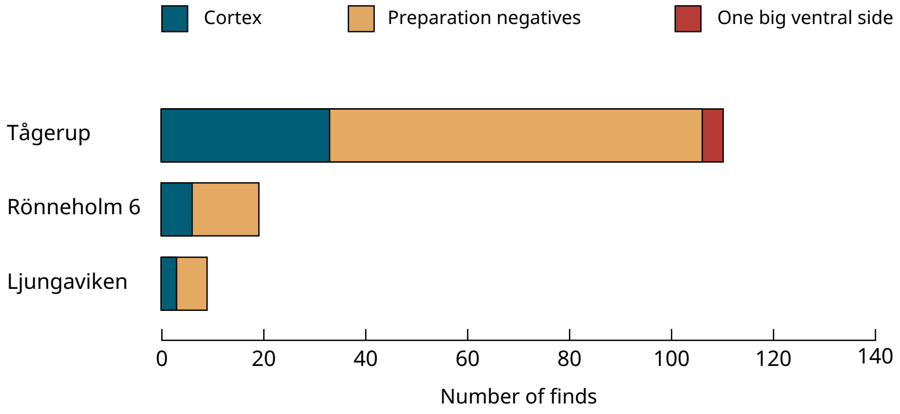


Figure 60. Core back (KR) on recorded cores from focus area 2a, by site.

opposite sides of the platform (6.5%) as well as cores with two fronts that are placed independently from each other (3.2%). In the assemblages from Rönneholm 6 and Ljungaviken, dual-fronted cores all have the second front placed independently (Fig. 58).

Handle core on flake (HCF)

Most of the cores from the focus area are made from nodules. However, the materials from Ljungaviken contain a higher number of cores made from flakes (37.5%) than the other sites, although it is the smallest assemblage. This is followed by Tågerup (18.5%) and Rönneholm (14.3%) (Fig. 59).

Core back (KR)

The shaping and preparation of the core back across the focus area has commonly been executed by the removal of flakes. The sites Tågerup (66.4%) and Rönneholm 6 (68.4%) show similar percentages of this trait, while a higher percentage can be found in the smaller assemblage from Ljungaviken (66.7%). Core back shaping carried out by the removal of one large flake was only found in the materials from Tågerup (3.6%). The remaining cores from each site have a cortex-covered back (Fig. 60).

Core side 1 (KS1) and core side 2 (KS2)

The shaping and preparation of the core sides show both similarities and differences within the focus area. See details in Table 35.

The cores from the Tågerup assemblage have similar patterns on both core sides. Most of the core sides were prepared by the removal of flakes (46.3-48%), followed by the removal of flakes with additional lateral edge platform preparation (24.4-26%), sides with one large ventral negative (13.8-14.6%) and cores with unprepared sides (9.8-10.6%). Less common attribute variations include core sides with cortex and lateral edge platform preparation (0.8%) or one large flake negative and lateral edge preparation (2.4%).

The assemblage from Rönneholm 6 shows some differences between KS1 and KS2. For instance, on KS1 there is more remaining cortex (26.3%) compared to KS2 (10%). Another difference is that KS1 more often shows one flake negative (15.8%) compared to KS2 (5%). KS2 more commonly has flake negatives (45%) compared to KS1 (15.8%). However, it should be noted that the number of recorded cores from Rönneholm 6 is small and the numbers in absolute amounts are not significant.

The assemblage from Ljungaviken is very small and generally shows similar patterns on both core sides. Core side preparation is mainly done by removing one flake (40-55.6%), or multiple flakes (11.1-20%) from the side of the core. The rest of the core sides were left unprepared (20-22.2%).

A comparison between the number of cores with and without lateral edge preparation shows some differences within the focus areas (Fig. 61). The cores from Tågerup have similar patterns on both core sides (27.6-29.2%), but these amounts are generally lower than on the cores from Rönneholm 6 (40-42.1%). The cores from Ljungaviken generally have lower amounts of lateral edge preparation, with 11.1% on KS1 and 20% on KS2.

Table 35. Core side preparations (KS1 and KS2) in focus area 2a, by site.

	Cortex (1)	Flake negatives (3)	One flake negative (4)	Cortex + lat edge prep (6)	Flake negatives + lat edge prep (7)	One flake negative + lat edge prep (8)	Number of finds total
Tågerup KS1	12 (9.8%)	57 (46.3%)	18 (14.6%)	1 (0.8%)	32 (26%)	3 (2.4%)	123 (99.9%)
Tågerup KS2	13 (10.6%)	59 (48%)	17 (13.8%)	1 (0.8%)	30 (24.4%)	3 (2.4%)	123 (100%)
Rönneholm KS1	5 (26.3%)	3 (15.8%)	3 (15.8%)	0 (0%)	8 (42.1%)	0 (0%)	19 (100%)
Rönneholm KS2	2 (10%)	9 (45%)	1 (5%)	1 (5%)	7 (35%)	0 (0%)	20 (100%)
Ljungaviken KS1	2 (22.2%)	1 (11.1%)	5 (55.6%)	0 (0%)	0 (0%)	1 (11.1%)	9 (100%)
Ljungaviken KS2	2 (20%)	2 (20%)	4 (40%)	0 (0%)	2 (20%)	0 (0%)	10 (100%)

Platform morphology (PMORPH)

Platform morphology varies between the different assemblages. In the material from Tågerup, almost half of the cores have smooth platforms (48%), while the rest of the assemblage is made up of cores with faceted platforms (47.2%) and partly faceted platforms (4.7%).

The Ljungaviken assemblage contains an almost equal distribution of cores with smooth platforms (4/10 examples), faceted platforms (3/10 examples) and

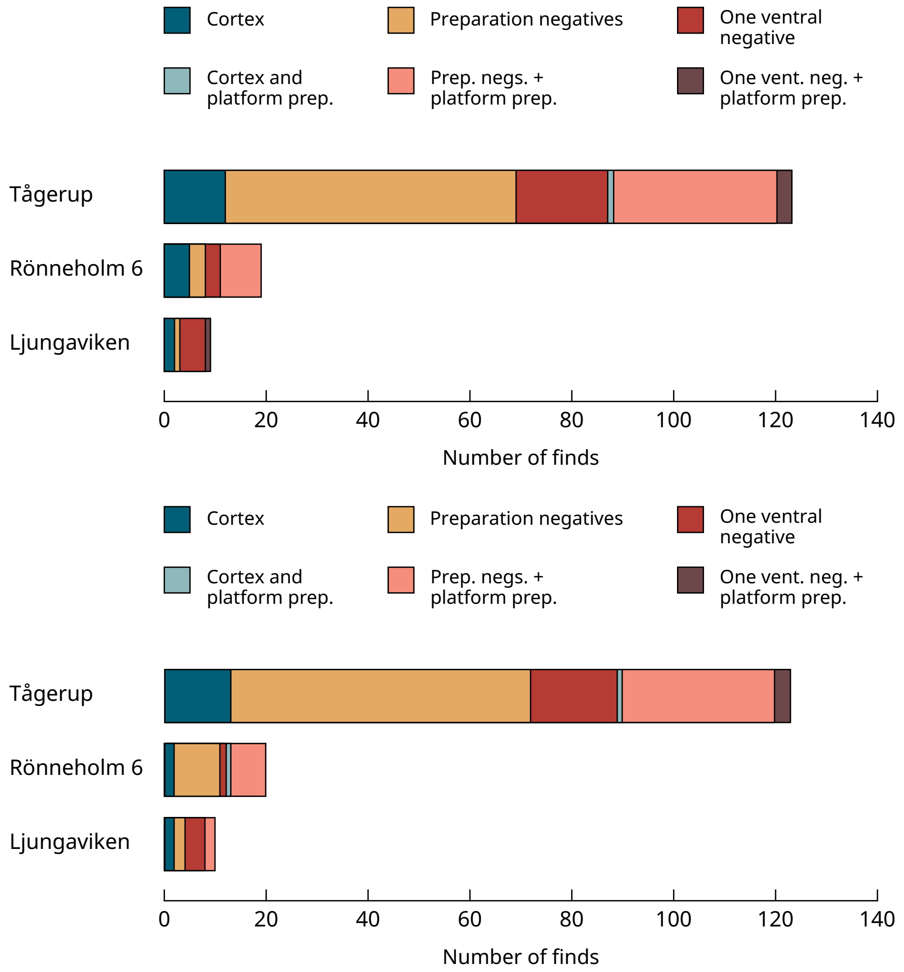


Figure 61. Core side 1 (KS1, first bar graph) and core side 2 (KS2, second bar graph) on recorded cores from focus area 2a, by site.

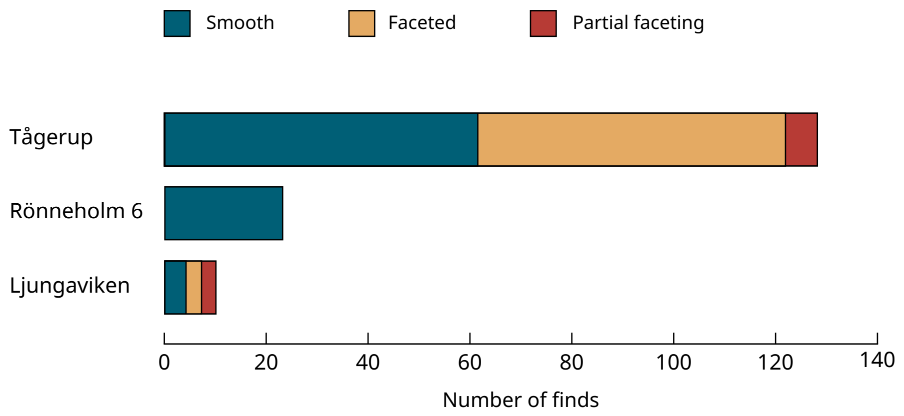


Figure 62. Platform morphology (PMORPH) on recorded cores from focus area 2a, by site.

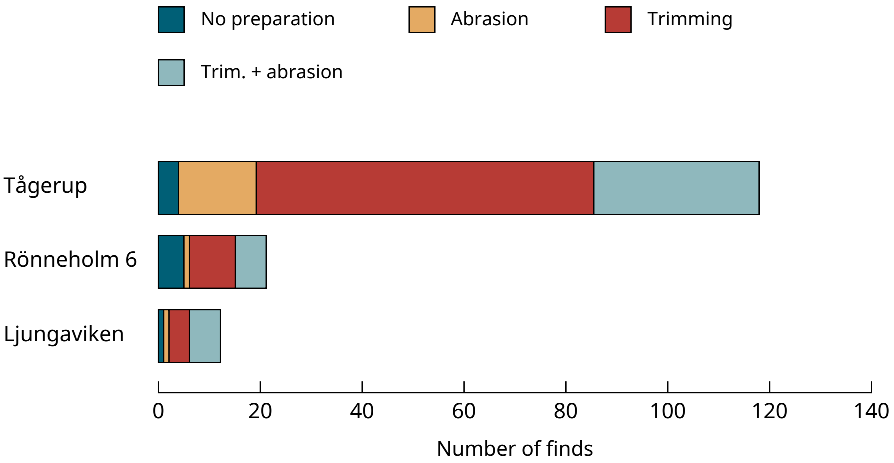


Figure 63. Platform preparation core dorsal (PPCD) on recorded cores from focus area 2a, by site.

partly faceted platforms (3/10). The cores from Rönneholm 6, however, all have smooth platforms (Fig. 62).

Platform preparation core dorsal (PPCD)

In the assemblage from Tågerup, trimming makes up 56.4%, trimming and abrasion make up 27.4% and only abrasion makes up 12.8%. Only 3.4% of the cores lack dorsal preparation.

A similar pattern can be seen in the assemblage from Rönneholm 6. Here, trimming exists on 42.9% of the cores, while trimming and abrasion are found on 28.6% of the cores. Abrasion on its own, however, was only found on 1 core (4.8%). Lastly, 23.8% of the cores lack dorsal preparation.

In the assemblage from the Ljungaviken site, most cores have either a combination of trimming and abrasion (6/12 examples) or trimming (4/12 examples). Only single finds show exclusively abrasion (1/12 examples) or a lack of dorsal preparation (1/12 examples) (Fig. 63).

Exterior platform angle (EPANG)

The exterior platform angle on the cores from the Tågerup site spans from 65 degrees to 120 degrees, almost displaying a normal distribution (Fig. 64). Most cores fall in the 85-, 90- and 95-degree categories (52.6%). The second largest group of cores falls in the 75-80-degree categories (24.6%). The third largest group falls into the 100-degree category (9.6%).

The exterior platform angles on the cores from Rönneholm span from 70-100 degrees, with most cores falling in the categories 75 degrees (26.7%), 80 degrees (20%), 90 degrees (20%) and 85 degrees (13.3%). These categories thus contain 80% of the cores from the site.

The cores from Ljungaviken span from 75 to 100 degrees, with most of them measuring either 75 degrees (3/9 examples), 85 degrees (2/9 examples) or 90 degrees (2/9 examples). However, the small number of recorded platform angles from both Rönneholm 6 and Ljungaviken makes it difficult to interpret the patterns.

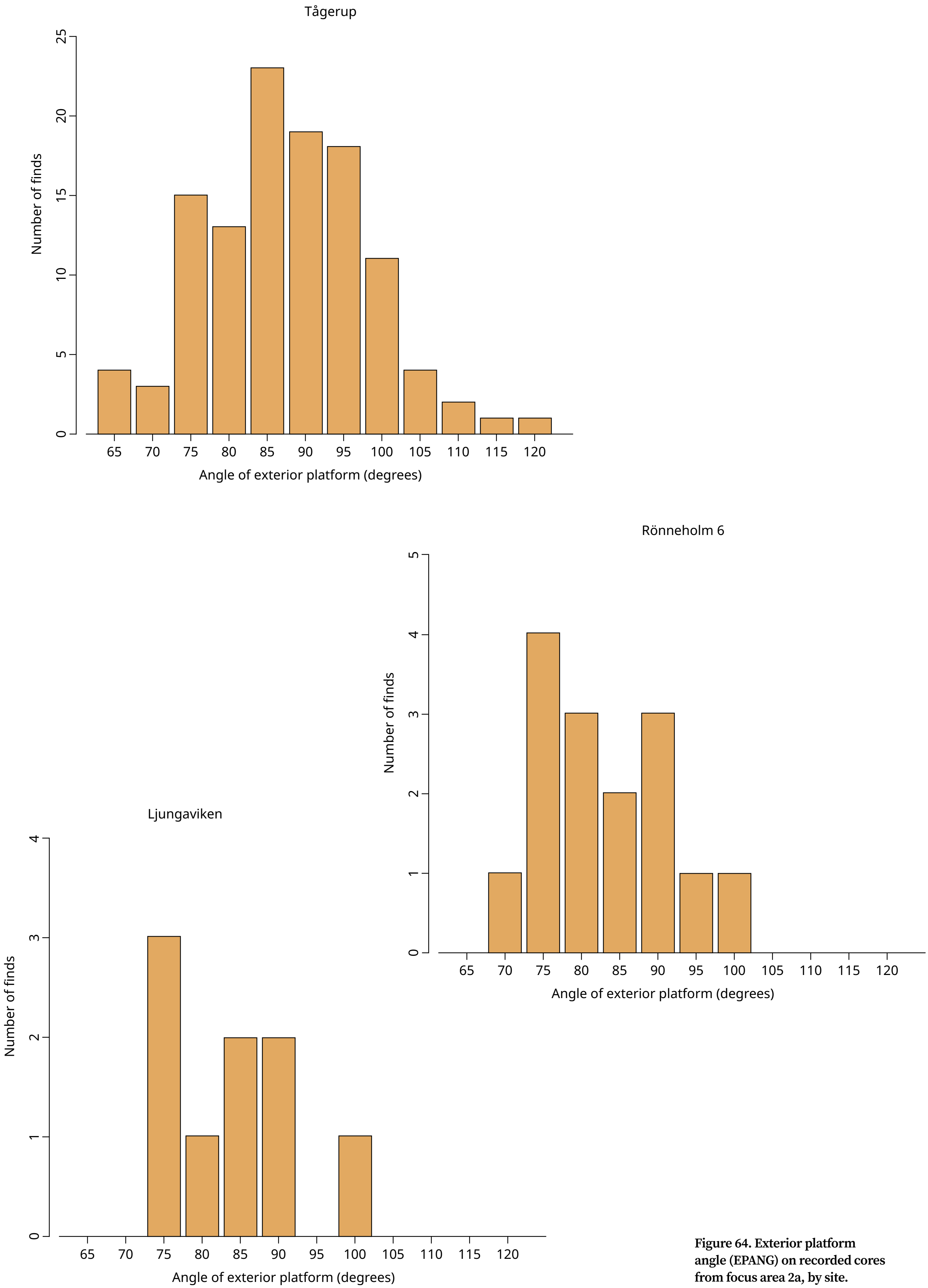


Figure 64. Exterior platform angle (EPANG) on recorded cores from focus area 2a, by site.

Focus area 2a – Tågerup

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	7.7	32.65	37.75	**38.29**	43.3	75.9	9.642352	134
Core width (B)	12.5	20.35	23.7	**24.21**	27.8	38.7	5.35174	135
Core length (D)	10.4	44	54.7	**55.15**	67.2	105.1	17.60804	129

Focus area 2a – Rönneholm 6

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	19	26.6	28.9	30.06	34.5	47.6	6.41891	25
Core width (B)	14.6	16.9	20.5	21.5	26.3	30.2	4.890082	25
Core length (D)	5.6	32.1	45.25	43.73	59.55	94.2	23.82148	24

Focus area 2a – Ljungaviken

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	6.6	24.5	29.15	*28.04*	33.98	49.4	12.14769	12
Core width (B)	12.4	16.2	18.3	*18.63*	21.3	25.1	4.046502	11
Core length (D)	5.9	31.35	35.2	*32.61*	36.7	44.2	9.86696	11

Table 36. Core sizes in focus area 2a, by site. The largest mean values are marked in bold and the smallest values are marked in italic.

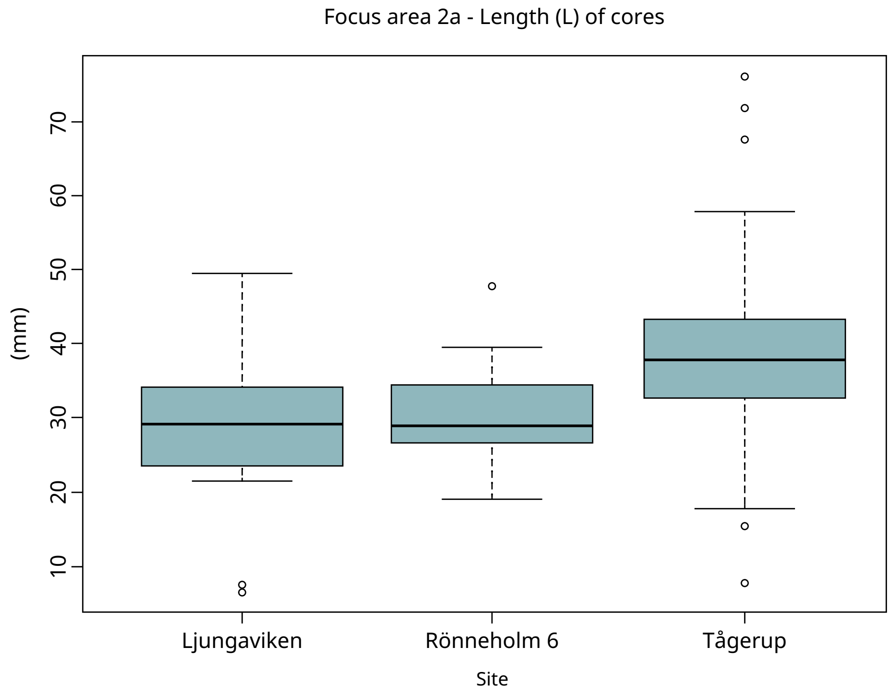
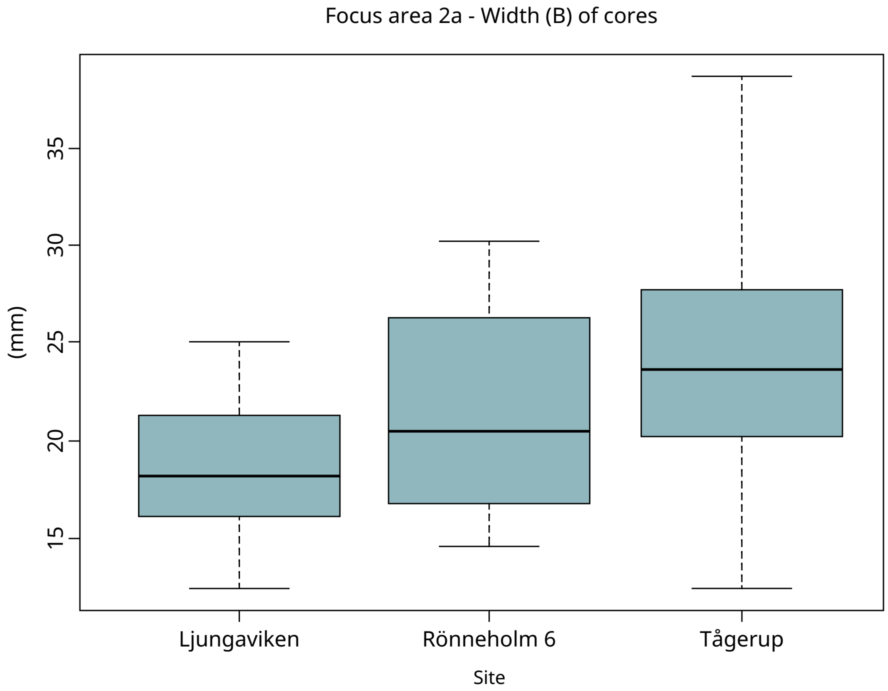
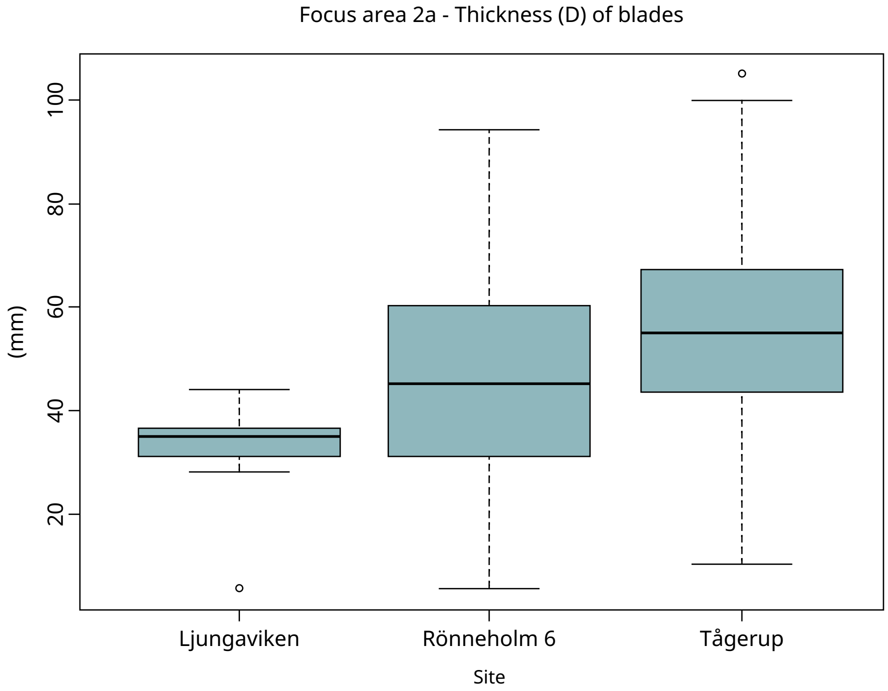


Figure 65 (continued on the following page). Boxplots of core height (L), width (B) and thickness (D) measured in millimetres within focus area 2a, by site. Mean values and interquartile ranges are shown in Table 36.

Core size (L, B and D)

The size of the cores varies from site to site (see Table 36; Fig. 65). The cores from Tågerup are the largest within the focus area (see details in Table 1). According to the analysis, there is a lot of variation within the assemblage, especially relating to the core length, as underlined by the large standard deviation.


Focus area 2a - Width (B) of cores


Focus area 2a - Thickness (D) of blades

The cores from Rönneholm 6 are smaller than the Tågerup cores but larger than the Ljungaviken cores. The Rönneholm 6 dataset gives a more homogenous impression of the core sizes than the Tågerup assemblage, as based on the standard deviation, except relating to core length (D), which shows more variation

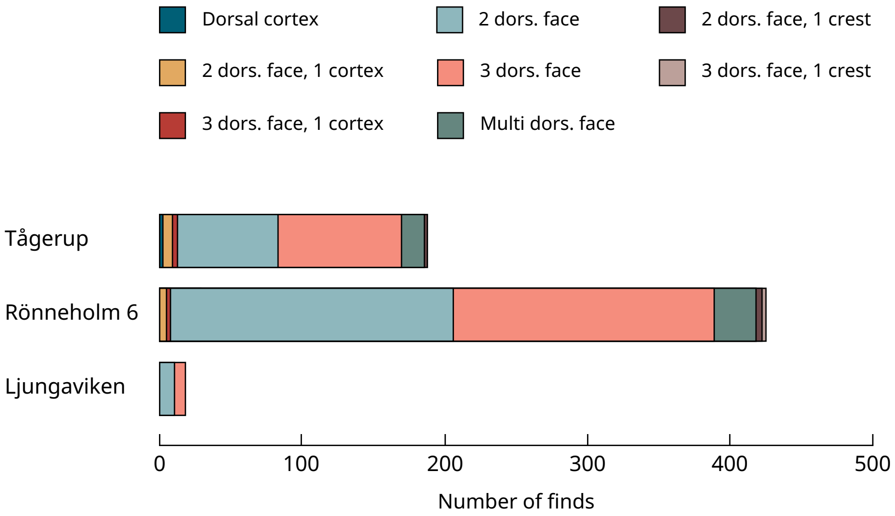


Figure 66. Dorsal blade face (DBF) on recorded blades from focus area 2a, by site.

within the assemblage. The standard deviations relating to the Tågerup cores show variety in height (L) and, to a higher degree, in measurements of length (D).

The cores from Ljungaviken are the smallest among the assemblages in the focus area. The standard deviation shows more variation relating to core height (L), followed by length (D).

Dorsal blade face (DBF)

The blades from the sites in Southern Sweden mostly have two or three dorsal blade faces (Fig. 66). At Ljungaviken, all blades show two or three dorsal blade faces, while 158 blades in the Tågerup assemblage have one of the two variants, making up 84.5% of the whole assemblage. The site Rönneholm 6 presents 381 finds with either 2 or 3 dorsal blade faces amounting to 90%.

In the two larger assemblages, Tågerup and Rönneholm 6, there are also other morphologies of dorsal blade faces available, but in much smaller amounts. The Tågerup assemblage contains only 12 blades (6.4%) with cortex and the Rönneholm site had only 7 blades (1.7%) with cortex.

Small parts of these assemblages also have multiple (more than three) dorsal blade faces. In the Tågerup assemblage, these amount to 16 blades (8.6%) and in the Rönneholm site 30 blades (7.1%) are available. Only a handful of blades from the whole focus area have dorsal blade faces with crests.

Blade termination 1 (BT1) and blade termination 2 (BT2)

In the focus area, a large portion of blades from the sites are not remaining, meaning that the blades were broken during or after their production (Fig. 67, top). This is true for 96.4% of blades from Ljungaviken, 55% of blades from Rönneholm 6 and 45.2% of blades from Tågerup. If still present, blades from Ljungaviken are terminated by hinged breaks. There is more variation from the two other sites, with Rönneholm blades having many ideal breaks (27.6%) and feathered terminations (15.5%). Some single blades were terminated via plunging or hinging. The blades from Tågerup follow a similar pattern to the blades from Rönneholm, with a larger portion of ideal breaks (31.9%) followed by some feathered breaks (20.7%) and a few blades with hinged breaks.

The shape of the distal part of the blade was recorded to learn about the core shape (Fig. 67, second bar graph). However, this was not recorded for the Ljunga-

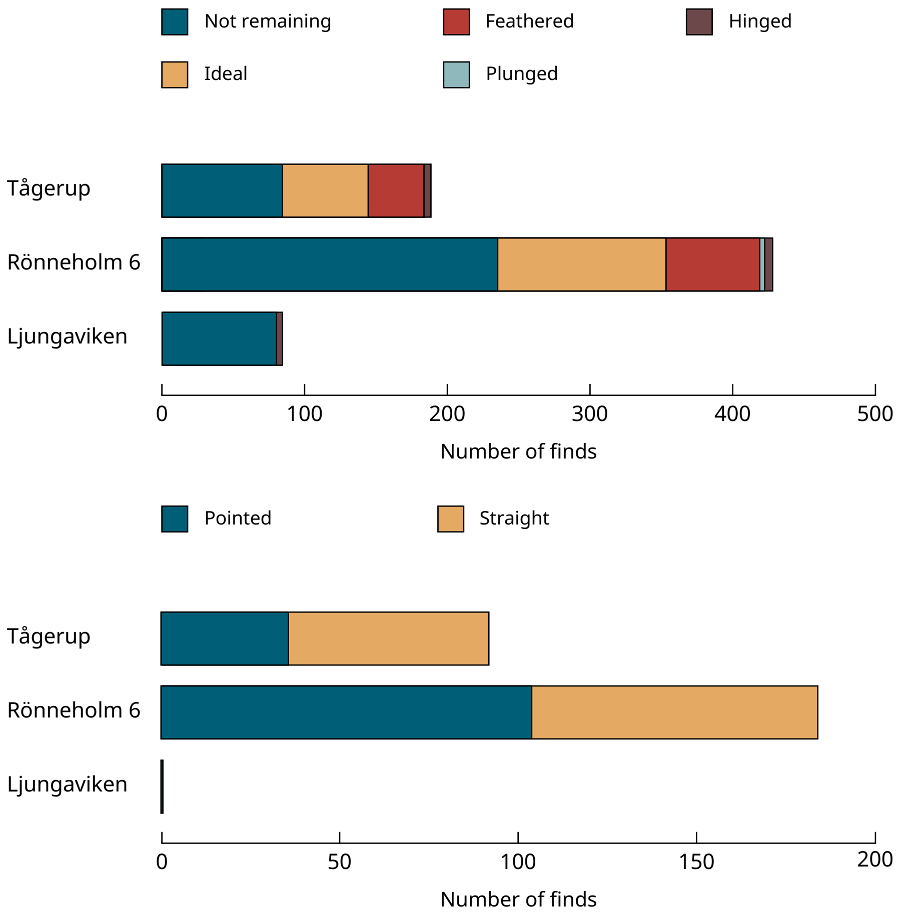


Figure 67. Blade termination 1 (BT1, first bar graph) and blade termination 2 (BT2, second bar graph) on recorded blades from focus area 2a, by site.

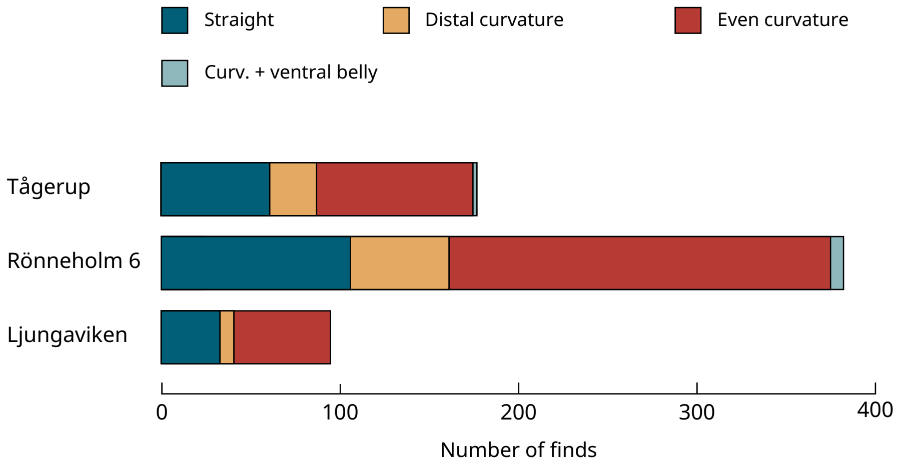


Figure 68. Blade curvature (CURV) on recorded blades from focus area 2a, by site.

viken blades. The ratios between straight and pointed ends are rather even on the two other sites. In the Rönneholm assemblage, there is a slight majority of blades with pointed ends (56.5%). In the Tågerup assemblage, there is instead a slight majority of blades with straight distal ends (60.7%).

Blade curvature (CURV)

All sites in the focus area contain around 50% of blades with even curvature: in the Ljungaviken assemblage, 56.8% of blades are evenly curved, the Rönneholm assemblage contains 56% of blades with even curvature and in the Tågerup assemblage the number amounts to 50%.

The second most common group is represented by blades without curvature. Straight blades make up 34.7% of the Ljungaviken assemblage, 27.7% of the Rönneholm assemblage and 34.7% of the Tågerup assemblage. Distal curvature also appears, to various degrees, in the different materials. Only 8 examples (8.4%) are present among the Ljungaviken blades. A larger part is found among the Rönneholm blades, which has 14.4% of blades with distal curvature. Similarly, the Tågerup assemblage contains 14.8% of blades with this feature. Only a few blades from the two bigger assemblages, Tågerup and Rönneholm 6, show curvature and a ventral belly (Fig. 68).

Blade twist (TWIST)

The twisting of blades is similarly common in all the assemblages in the focus area (Fig. 69). Blade twist only occurs on 35.8%, 31% and 32.6% at Ljungaviken, Rönneholm 6 and Tågerup, respectively. Thus, most blades from all sites lack any twist.

Wallner lines (WN)

There is some local or regional variety in the amount of Wallner lines within this focus area (Fig. 70). In the assemblage from Ljungaviken, there are almost equal parts of blades with no Wallner lines (39.7%) and blades with fine Wallner lines (41.4%). The remaining 19% of blades have pronounced Wallner lines.

The blades from the Rönneholm 6 site instead show mainly fine Wallner lines (82.6%) with only small amounts of blades without Wallner lines (12.6%) or pronounced lines (4.9%). Similarly, the Tågerup blades have mainly fine Wallner lines (75.9%) followed by no Wallner lines (15.7%) and pronounced lines (8.4%).

Blade regularity (REG)

Blades in the focus area are most commonly regular. In the Ljungaviken assemblage, 73.7% of blades are regular. In the materials from Rönneholm 6 and Tågerup, regularity appears on 80.6% and 67.5%, respectively (Fig. 71).

In the Ljungaviken materials, remaining blades are mostly irregular (22.8%). Only a few blades (4) have extreme regularity. The same trend is found in the Rönneholm assemblage which contains 15.1% of irregular blades and 4.3% of extremely regular blades. On the contrary, the Tågerup assemblage presents more blades that are extremely regular (17.3%) compared to irregular blades (15.2%).

Platform preparation dorsal (SFPD)

Throughout the research area, platform preparation in the form of abrasion, trimming and a combination of the two are commonly found. Only a few examples from the larger assemblages lack any sort of dorsal platform preparation (Fig. 72).

The Ljungaviken assemblage contains almost equal parts of blades with abrasion (40.8%) and those with abrasion and trimming (38.3%). Most of the remaining blades in the assemblage are prepared using trimming (20.8%).

Among the blades from Rönneholm 6, most blades are prepared using abrasion (34.8%) followed closely by the use of abrasion and trimming (33.4%) and

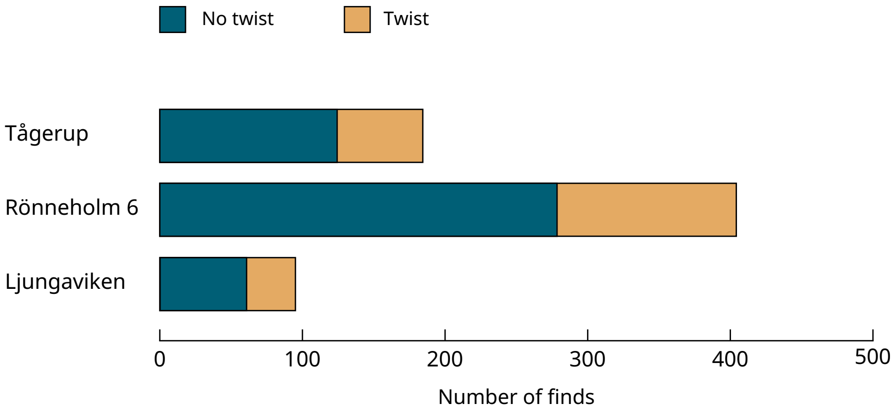


Figure 69. Blade twist (TWIST) on recorded blades from focus area 2a, by site.

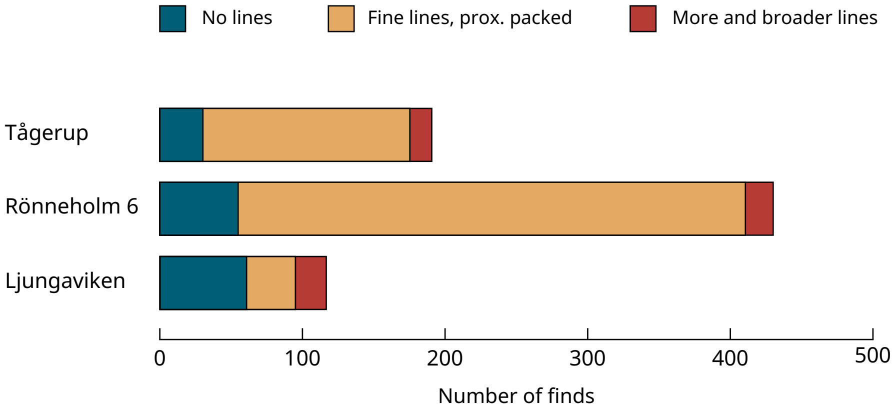


Figure 70. Wallner lines (WN) on recorded blades from focus area 2a, by site.

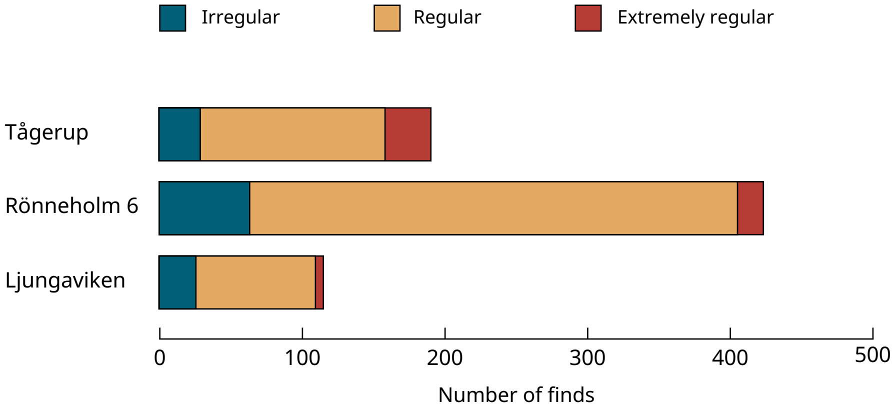


Figure 71. Blade regularity (REG) on recorded blades from focus area 2a, by site.

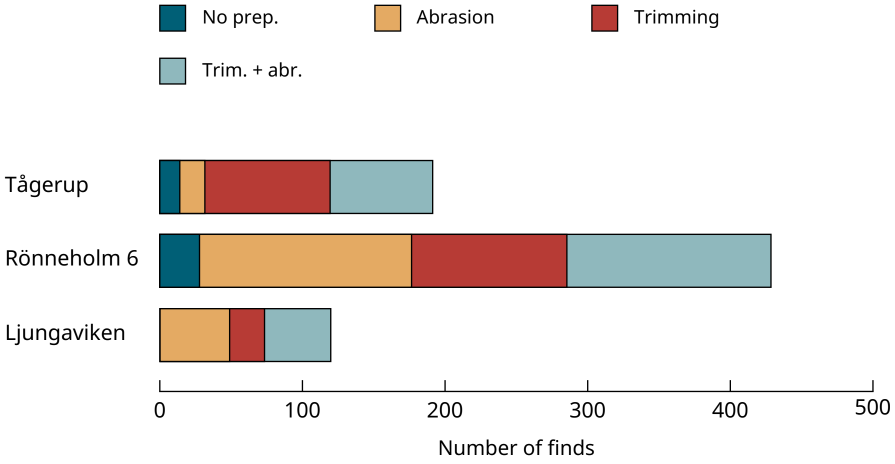


Figure 72. Platform preparation dorsal (SFPD) on recorded blades from focus area 2a, by site.

those that only have trimming (25.2%). A small part of the assemblage lacks platform preparation (6.5%).

In the Tågerup material, most blades are prepared using trimming (46.1%) followed by trimming in combination with abrasion (37.2%). Only smaller parts of the assemblage are made up of blades prepared using abrasion (9.4%) or no preparation (7.3%).

Platform preservation (SFPE)

The blade preservation is rather homogenous in the focus area (Fig. 73). Most blades in all assemblages have smooth platforms. Smooth platforms appear on 87.8% of blades from Ljungaviken, 97.7% of blades from Rönneholm and 91% of blades from Tågerup.

Faceting appears on only small portions of the assemblages. In the Ljungaviken assemblage, this amounts to 10.4%. Within the Rönneholm material, it is represented by only 0.5% and in the Tågerup assemblage by 5.8% of blades. In the two larger assemblages, Rönneholm and Tågerup, there were also small portions of blades with crushed platforms (4-8 blades). Cortex on the platform was found only in some single cases.

Conus formation (KE)

Conus formation is rather uncommon, but existent, in the focus area (Fig. 74). In the Ljungaviken assemblage, 78.1% of blades lack any sort of conus formation. In the Rönneholm assemblage 86.2% of blades lack conus formation, while the same is true for 78.7% of blades from Tågerup.

In the remaining parts of the assemblages, most platforms show conus formation visible on the platform and proximal ventral side.

Lip (SL)

In all the analysed assemblages from the focus area, a diffuse lip or no lip are the two most common lip characteristics (Fig. 75). In the Ljungaviken assemblage, 75.8% of blades have a diffuse lip, while 13.3% lack lip formation. Additionally, 10% of blades have lateral/partial lips and only 0.8% of blades (1 blade) have a pronounced lip. Lateral/partial lips are only featured on blades from this site within the focus area.

In the Rönneholm assemblage, 58% of blades have diffuse lips. The remaining material is almost exclusively made up of blades with no lip (40.6%). Only a small portion (1.4%) of the blades have pronounced lips.

The Tågerup assemblage follows the same trend with 54.5% of the assemblage made up of blades with diffuse lips, followed by 44% of blades without lips. Only 3 blades (1.6%) have a pronounced lip.

Platform width (SFRD) and platform thickness (SFRK)

The details of butt sizes of the blades from the focus area can be found in Table 37 below. Some observations to be noted are that the blade butts from Ljungaviken are generally larger, with larger mean and median, than those from the two other sites from focus area 2a. The standard deviation relating to both width and thickness of butts is also larger than in the other assemblages. I do not consider this a difference in technology, but rather a difference in the recording method. Ljungaviken was the first assemblage to be recorded within this project and the

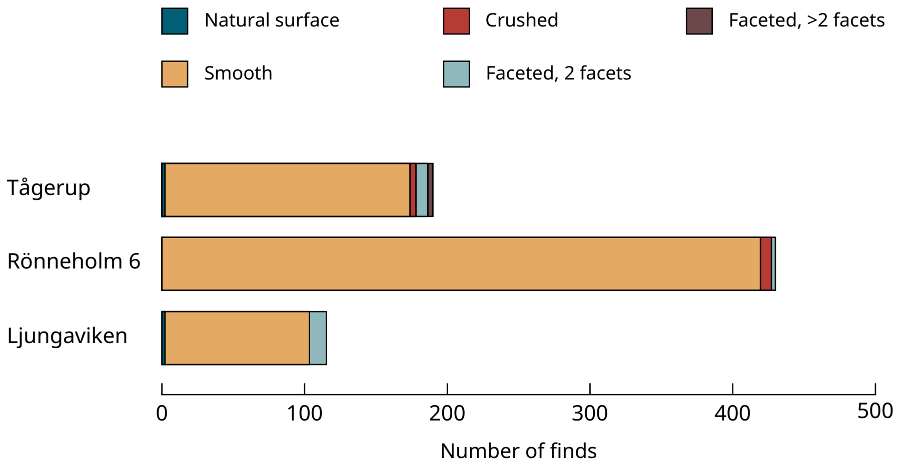


Figure 73. Platform preservation (SFPE) on recorded blades from focus area 2a, by site.

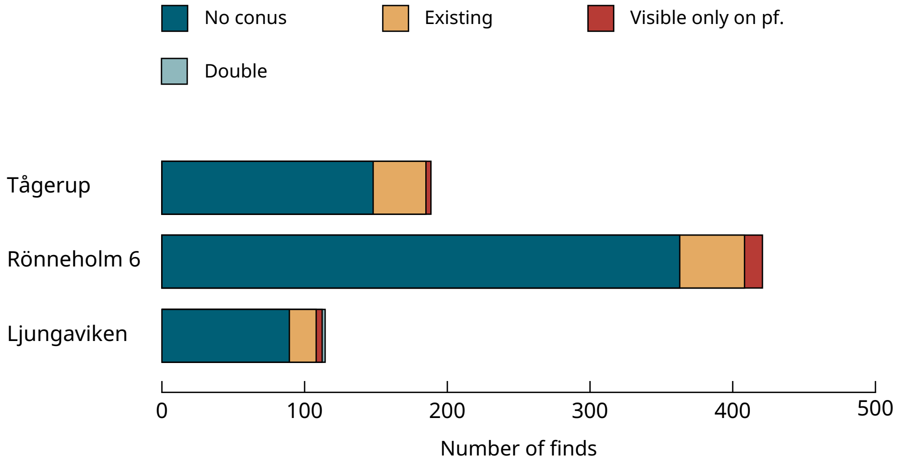


Figure 74. Conus formation (KE) on recorded blades from focus area 2a, by site.

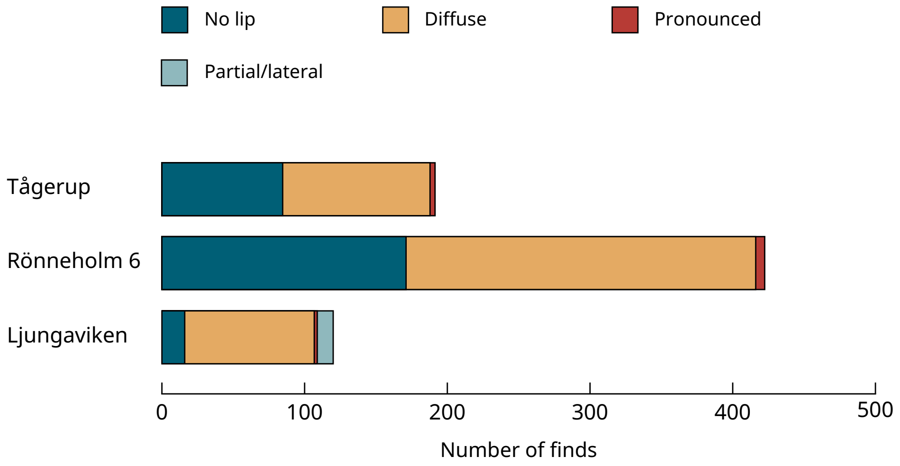


Figure 75. Lip (SL) on recorded blades from focus area 2a, by site.

strategy for the selection of blades for recording was still being developed, thus a larger variation of blade sizes (and therefore) butts was recorded as a consequence.

The two assemblages Rönneholm 6 and Tågerup were recorded later when the strategy for the selection of blades for recording was established, which is mirrored in the butt sizes that are very similar in these assemblages. One difference between the two is found in the standard deviation of butt width, where there is more variety on the blade butts in the Tågerup assemblage than in the Rönneholm assemblage.

Focus area 2a – Ljungaviken

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Butt width (SFRD)	0.6	2.6	3.6	4.134	5.15	12	2.174828	119
Butt thickness (SFRK)	0.3	1	1.4	1.545	1.9	4.7	0.835312	119

Focus area 2a – Rönneholm 6

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Butt width (SFRD)	0.7	2.2	2.7	2.864	3.2	8.8	1.000489	421
Butt thickness (SFRK)	0.4	0.8	1	1.114	1.3	4.7	0.481007	421

Focus area 2a – Tågerup

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Butt width (SFRD)	0.7	2.1	2.7	2.92	3.5	8.7	1.313757	185
Butt thickness (SFRK)	0.3	0.8	1	1.058	1.2	3	0.41671	185

Table 37. Platform width (SFRD) and platform thickness (SFRK) in focus area 2a, by site.

Focus area 2a – Ljungaviken

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Blade length (L)	3.4	25.02	31.1	**39.76**	48.65	133.1	25.95156	38
Blade width (B)	3	6.8	8.75	**11.25**	14.82	27.5	5.554875	120
Blade thickness (D)	0.7	1.5	2.1	**2.802**	3.825	10.5	1.689114	120

Focus area 2a – Rönneholm 6

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Blade length (L)	9.4	14.38	18.1	*19.67*	23.3	54.3	6.964467	196
Blade width (B)	2.7	5	5.8	*6.155*	6.75	17	2.052284	431
Blade thickness (D)	0.5	1	1.2	*1.341*	1.5	4.1	0.5611965	431

Focus area 2a – Tågerup

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Blade length (L)	12.6	21	25.3	25.6	29.5	52.6	6.695162	97
Blade width (B)	2	5.9	6.8	7.036	8	12	1.741321	191
Blade thickness (D)	0.7	1.3	1.6	1.732	1.95	6.1	0.7515429	191

Table 38. Blade sizes in focus area 2a, by site. The largest mean values are marked in bold and the smallest values are marked in italic.

Blade sizes – Length (L), width (B) and thickness (D)

The details of the sizes of the blades from the focus area can be found in Table 38 and in Fig. 76. The differences that were mentioned for SFPD and SFPK can also be observed in the data relating to length, width and thickness of blades.

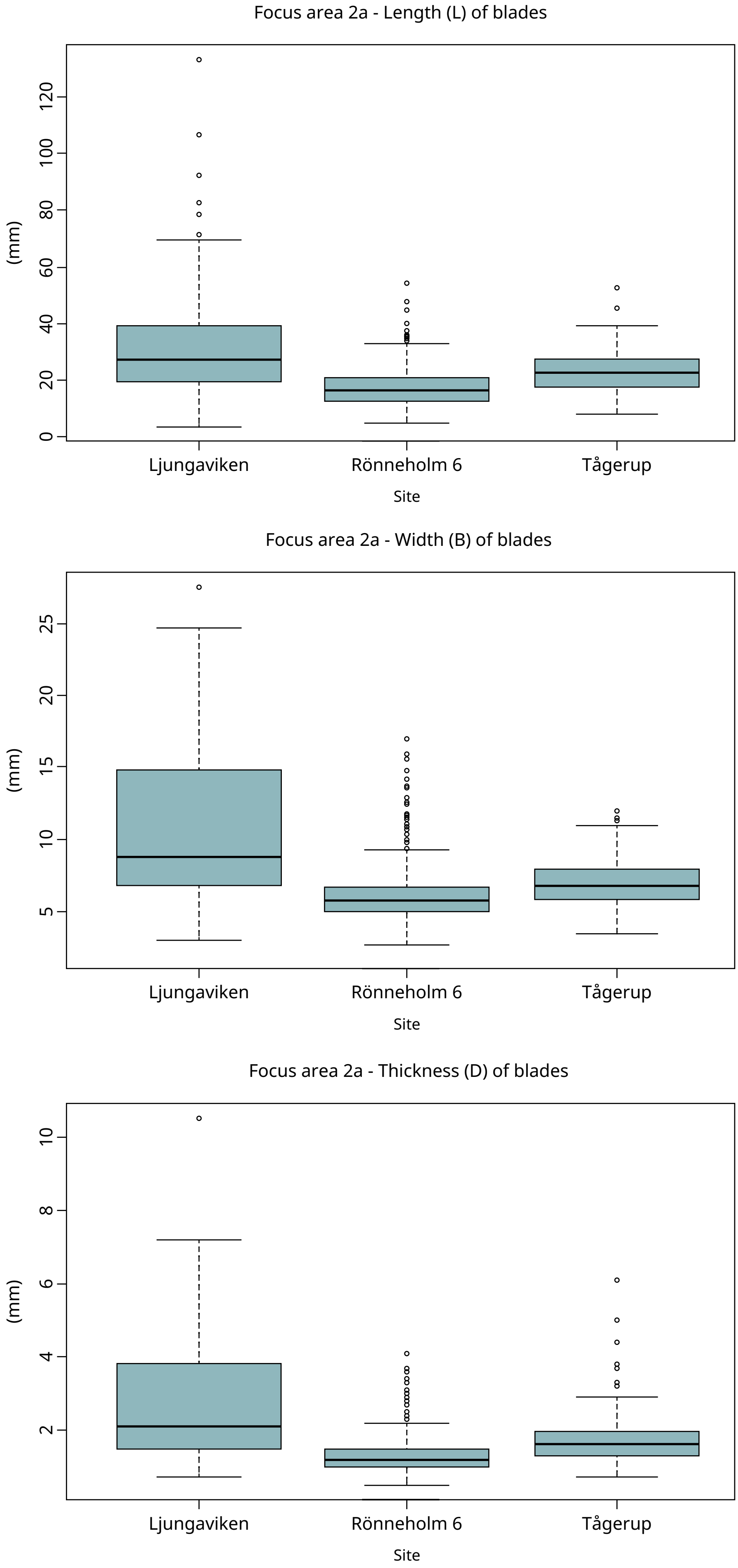


Figure 76. Boxplots of blade length (L), width (B) and thickness (D) measured in millimetres within focus area 2a, by site. Mean values and interquartile ranges are shown in Table 38.

The blades from Ljungaviken have a greater mean length, width and thickness than those from the other two sites. Again, this is most probably a result of the recording strategy rather than a true technological difference.

When comparing the sizes of blades from Rönneholm and Tågerup, there are also some differences in sizes. The blades from Rönneholm are smaller in length, with a mean of 19.67 mm compared to the Tågerup blades, which have a mean of 25.6 mm. Additionally, the mean width of the Rönneholm blades is almost 1 mm less than that for Tågerup and the mean thickness is also slightly smaller in the Rönneholm assemblage compared to Tågerup.

The standard deviation of length and width in the Rönneholm assemblage is slightly larger than in the Tågerup assemblage, indicating a bit more variety in size within the Rönneholm assemblage. The blade thickness between the two assemblages, however, shows the opposite trend.

Summary for focus area 2a

The cores from focus area 2a commonly have a single platform, a single core front and are most often made from nodules. The core rejuvenation strategy is varied within the region. The same is true for platform morphology. The back of the core is often shaped by striking away multiple flakes, as is common on the sides of the core. Additionally, the core sides are often prepared by removing one large flake or are kept unprepared. Lateral edge preparation exists on around 30% of the assemblage from Tågerup and on ca. 40% of the cores from Rönneholm, with smaller amounts on the cores from Ljungaviken. Core front preparation often appears in the form of trimming or a combination of trimming and abrasion. The angle between the core front and the platform often falls between 80-95 degrees or 75-90 degrees. Average cores sizes vary between sites.

Blades from F2a were mainly produced during the main blade production phase. The distal ends are often not remaining (broken), followed by ideal and feathered ends. The blades from Ljungaviken are almost all broken. Around 50% of blades from each site are evenly curved with the remaining assemblage consisting of straight, or alternatively, distally curved blades. Between 30-35% of blades are twisted. The assemblages from Tågerup and Rönneholm 6 have a majority of blades that display fine Wallner lines, while the Ljungaviken assemblage has equal amounts of fine lines and no lines. Most blades from each site are regular. Platform preparation is done by means of abrasion, trimming or a combination of the two. In general, the blade butts are mainly smooth, with only smaller amounts of faceting. The blades from Ljungaviken have a slightly higher percentage of blade butts with faceting than the other sites. Most blades from each assemblage show no signs of conus formation. Most blades also have a diffuse lip, followed by no lip. The blade butts from Tågerup and Rönneholm 6 are rather similar, while the butts from Ljungaviken are larger. The blades from Ljungaviken are also larger in general. The blades from Tågerup and Rönneholm 6 are more similar in size, with only slightly larger blades from Tågerup.

6.1.1.3 Focus area 2b – Northern Germany

The assemblages in this focus area are varied in size, and are all represented by rather small assemblages, which makes an internal regional comparison between sites difficult. This is important to keep in mind as the results are being analysed (see further discussion in Chapter 7).

The blades from the sites Dreggers LA 3 and Owschlag LA 183 are not included in the analyses for several reasons. One is that the sites are palimpsests containing materials from various times. Secondly, the recording of these materials was done prior to the start of the project with a slightly different recording method and manner of material selection, which affects the data created in that recording.

The blade related data in this focus area is only represented by the site Satrup LA 2. There are two assemblages from the same site, excavated in 2010 and 2016. Due to some slight differences in the data from the two campaigns, and since the excavations took place at different areas of the site, it was decided to keep the datasets separate. Nonetheless, the two assemblages are similar enough to indicate that they are related to each other when considering temporality, material composition and technology.

Platform design (KSFA) and platform use (KSFN)

All cores from focus area 2b have a single platform (Fig. 77).

Core front design (KAAN)

Most of the cores have one single core front. Only on the largest site, Dreggers LA 3, is there one example (1/22 cores) of a core with a second front, which was placed on the opposite side of the platform (Fig. 78).

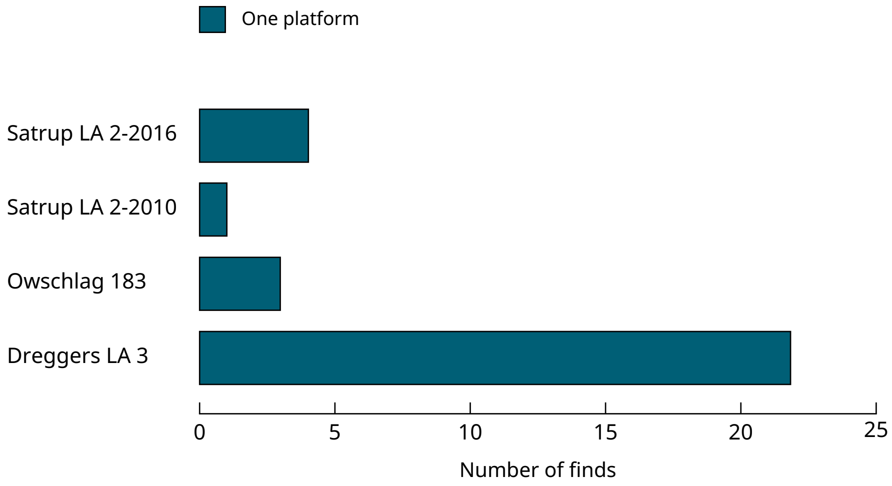


Figure 77. Platform design (KSFA) of recorded cores from focus area 2b, by site. Platform use (KSFN) is not displayed since all cores (100%) have one main platform (KSFN-1). The cores from Satrup LA 2 are also divided between two excavation campaigns in 2010 and 2016.

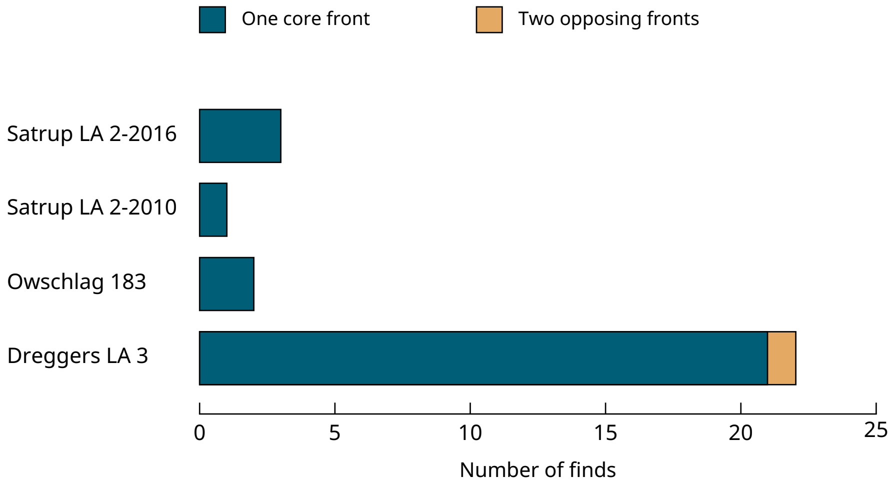


Figure 78. Core front design (KAAN) on recorded cores from focus area 2b, by site. The cores from Satrup LA 2 are also divided between two excavation campaigns in 2010 and 2016.

	Cortex (1)	Flake negatives (3)	One flake negative (4)	Cortex + lat edge prep (6)	Flake negatives + lat edge prep (7)	One flake negative + lat edge prep (8)	Number of recorded attributes
Dreggers KS1	1 (6.3%)	6 (37.5%)	1 (6.3%)	0 (0%)	7 (43.8%)	1 (6.3%)	16 (100.2%)
Dreggers KS2	2 (10%)	4 (20%)	1 (5%)	0 (0%)	12 (60%)	1 (5%)	20 (100%)
Satrup KS1	0	2	2	0	2	0	6
Satrup KS2	0	2	1	0	2	0	5
Owschlag KS1	0	0	0	0	0	1	1
Owschlag KS2	0	1	0	0	0	1	2

Table 39. Core side preparation in focus area 2b. The two core assemblages from Satrup (2010 and 2016) have been joined in one table. Percentages were only calculated for Dreggers. The other assemblages were considered too small for a relevant comparison (<10 finds).

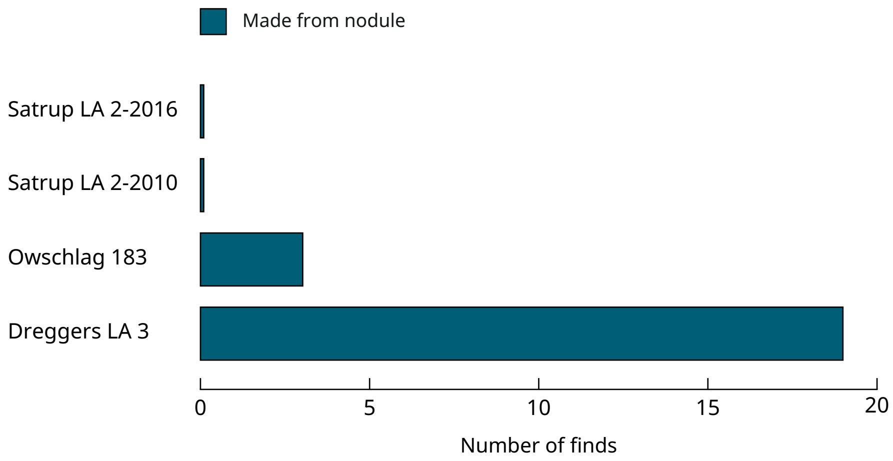


Figure 79. Handle core on flake (HCF) among recorded cores from focus area 2b, by site. The cores from Satrup LA 2 are also divided between two excavation campaigns in 2010 and 2016.

Handle core on flake (HCF)

All cores from focus area 2b were made from nodules. There are no examples of cores made from flakes (Fig. 79).

Core back (KR)

All cores from this focus area have either an unprepared back, with cortex, or multiple flake negatives. In the Dreggers assemblage, most of the core backs have flake negatives (11/17 examples, 64.7%). In the Satrup assemblage from 2010, the one recorded core had flake negatives. The assemblage from 2016 contained 3 cores, all of them with flake negatives on the back of the core. The Owschlag assemblage, with two recorded cores, had one with cortex and one with flake negatives (Fig. 80).

Core side 1 (KS1) and core side 2 (KS2)

The cores from Dreggers have similar patterns on each side of the cores (details in Table 39). The most common method of preparing the core sides is the removal of flakes in combination with lateral edge preparation (7), followed by the sole

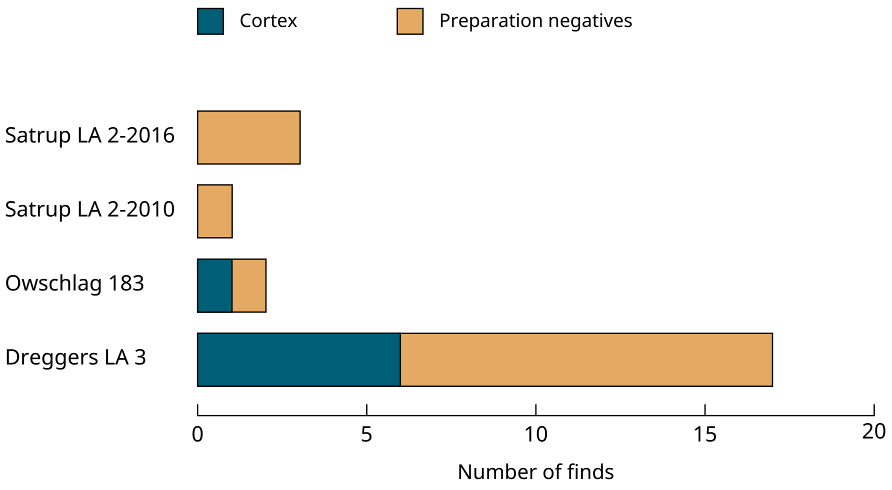


Figure 80. Core back (KR) on recorded cores from focus area 2b, by site. The cores from Satrup LA 2 are also divided between two excavation campaigns in 2010 and 2016.

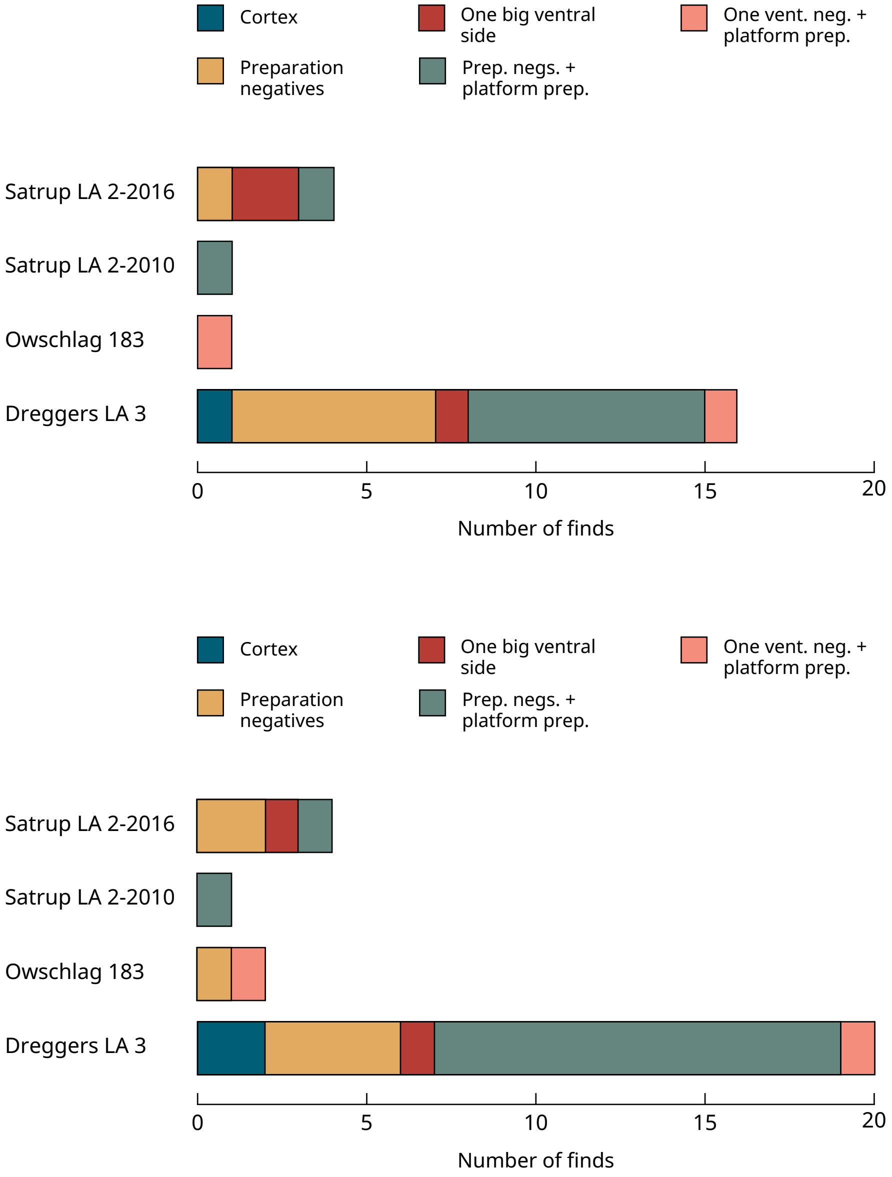


Figure 81. Core side 1 (KS1, second bar graph) and core side 2 (KS2, third graph) on recorded cores from focus area 2b, by site. The cores from Satrup LA 2 are also divided between two excavation campaigns in 2010 and 2016.

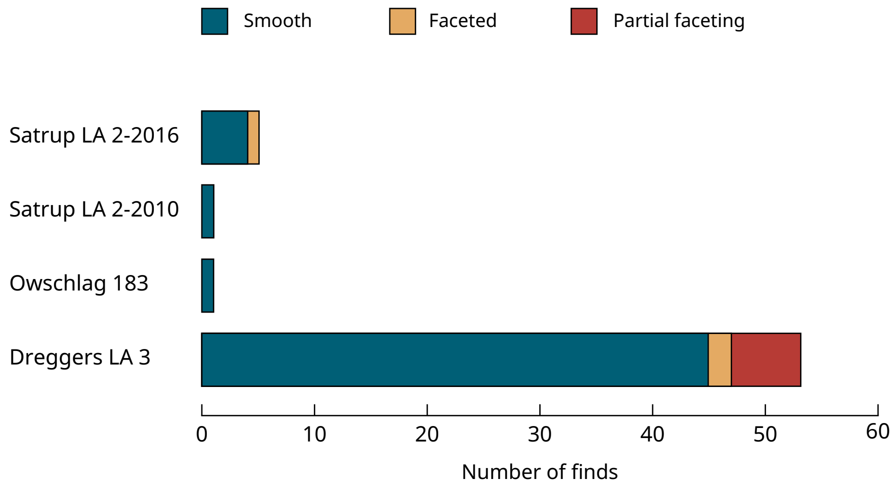


Figure 82. Platform morphology (PMORPH) on recorded cores from focus area 2b, by site. The cores from Satrup LA 2 are also divided between two excavation campaigns in 2010 and 2016.

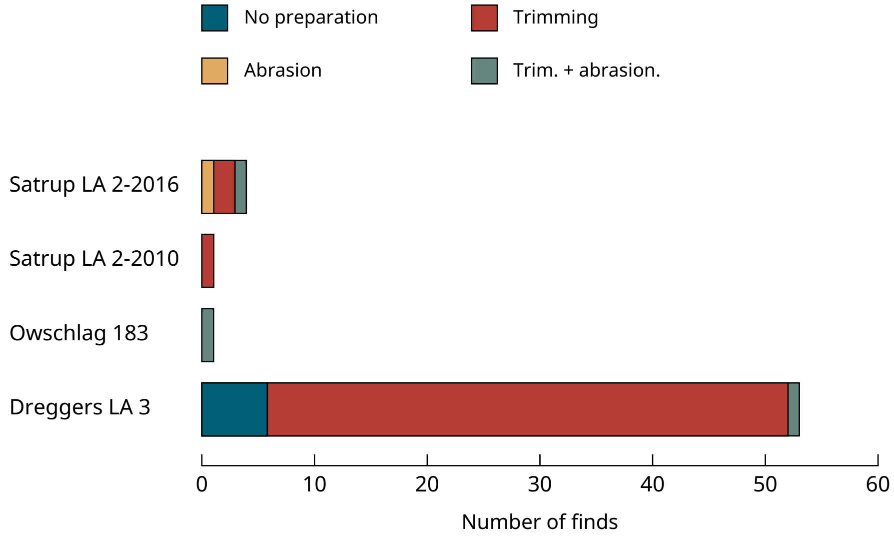


Figure 83. Platform preparation dorsal (PPCD) on recorded cores from focus area 2b, by site. The cores from Satrup LA 2 are also divided between two excavation campaigns in 2010 and 2016.

removal of flakes (3). The remaining attributes are almost equally distributed between attribute categories 1, 4 and 8.

The Satrup assemblage (combined data from 2010 and 2016) shows an even distribution of lateral edge preparation in the form of flake negatives (3), one flake negative (4) and flake negatives in combination with platform preparation (7).

The few single cores from the Owschlag assemblage have either flake negatives (3) or flake negatives in combination with lateral edge preparation (7) (Fig. 81).

Platform morphology (PMORPH)

Most cores in the focus area have smooth platforms. In the assemblage from Dreggers, 45/53 cores (84.9%) have smooth platforms. The remaining cores have faceted platforms (3.8%) or platforms with partial faceting (11.3%). The two assemblages from Satrup together contain five cores with smooth platforms and one core with a faceted platform. The one recorded core from Owschlag has a smooth platform (Fig. 82).

Focus area 2b – Dreggers LA 3

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	27.7	37	44.3	**43.31**	47.6	62.1	7.828533	53
Core width (B)	16.5	22.9	25	26.21	28.4	42.6	5.849216	53
Core length (D)	27.2	40.1	48.1	50.04	57.4	83.3	13.28917	53

Focus area 2b – Owschlag LA 183

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	11.4	29.81	48.22	40.27	54.7	61.18	25.82545	3
Core width (B)	19.03	19.12	19.22	*22.85*	24.76	30.3	6.452589	3
Core length (D)	45.38	49.16	52.95	55.96	61.26	69.56	12.36844	3

Focus area 2B – Satrup La 2

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	28.9	32.2	41.1	*39.12*	46.17	46.5	8.092321	6
Core width (B)	21.4	26.15	28.75	**29.47**	33.75	37.2	5.897683	6
Core length (D)	15.9	36.85	39.55	*44.43*	60.48	68.2	20.04412	6

Table 40. Core sizes in focus area 2b. The two core assemblages from Satrup (2010 and 2016) have been joined in one table. The largest mean values are marked in bold and the smallest values are marked in italic.

Platform preparation dorsal (PPCD)

Most cores have some form of dorsal preparation, most often in the form of trimming. The Dreggers assemblages contain 86.8% of cores with trimming. The second largest group lacks dorsal preparation (11.3%), while the last core has traces of both trimming and abrasion (1.9%). The cores from Satrup (2010 and 2016) have dorsal preparation in the shape of trimming (3/5 examples), abrasion (1/5 examples) or a combination of the two (1/5 examples) (Fig. 83).

Exterior platform angle (EPANG)

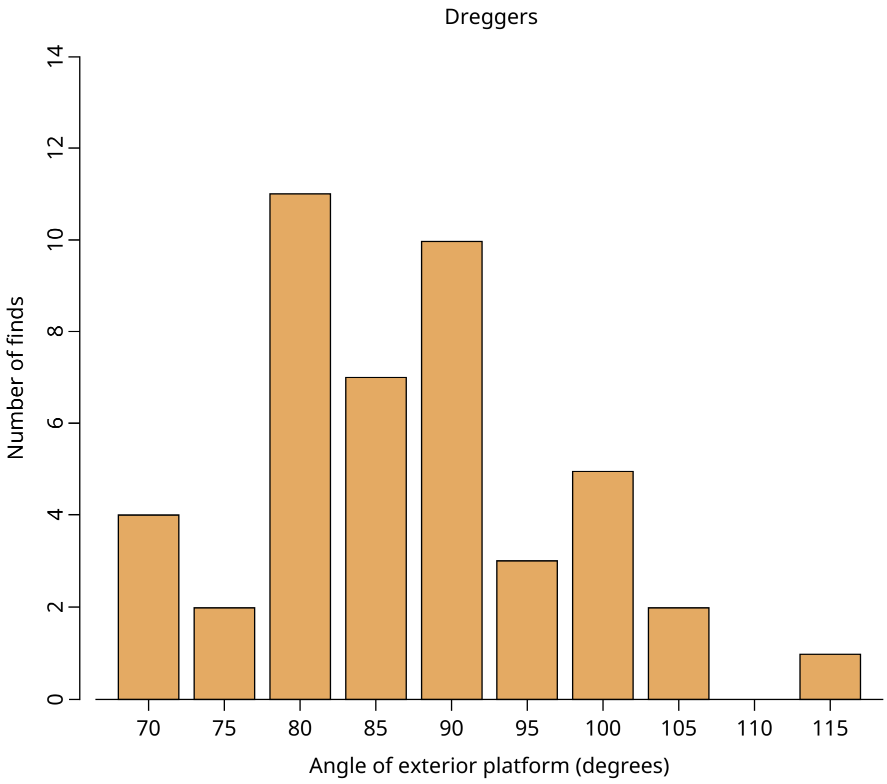
The cores from Dreggers have exterior platform angles ranging from 70-115 degrees. Most cores fall into the categories 80 degrees (24.4%), 85 degrees (15.6%) and 90 degrees (22.2%), placing a total of 62.2% of the cores within this range. Larger exterior platform angles of 95-115 make up another 24.4% of the assemblage. The remaining cores have smaller angles (13.3%).

One core from Owschlag has an angle of 80 degrees. The cores from Satrup (2010 and 2016) have single cores representing a spread of 65, 70, 85 and 90 degrees (Fig. 84).

Size of cores (L, B and D)

As already mentioned, the assemblages from the different sites in this focus area are very different in size, making reliable comparisons complicated. Nonetheless, some observations will be mentioned (Fig. 85). All details can be found in Table 40.

The size of the cores in the different assemblages are similar, generally between 39-44 mm high, 22-30 mm wide and 44-56 mm long. The standard de-



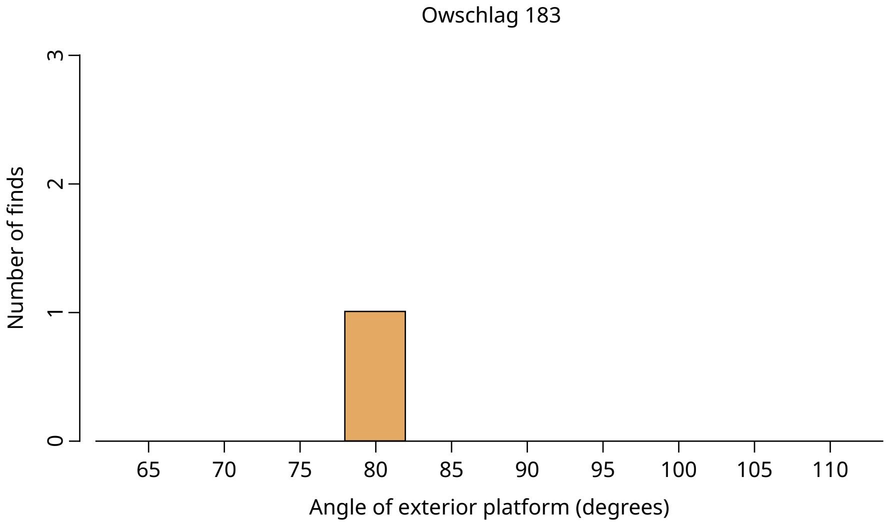
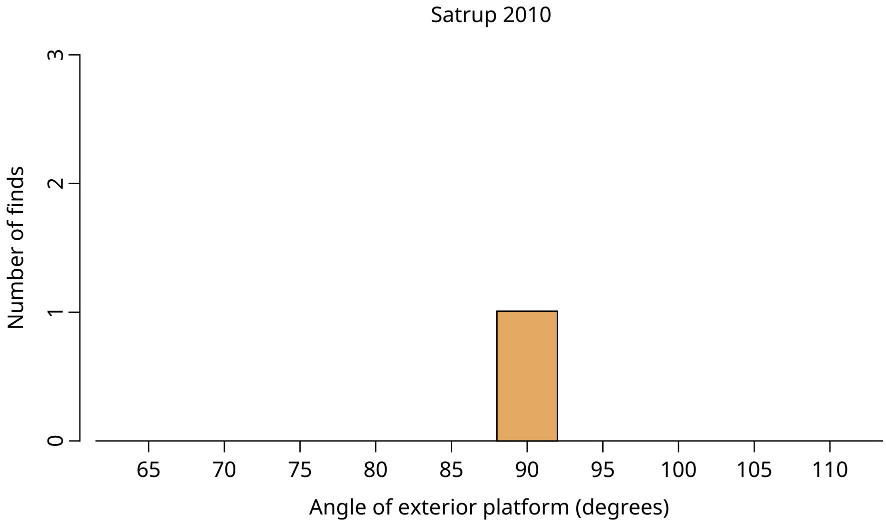
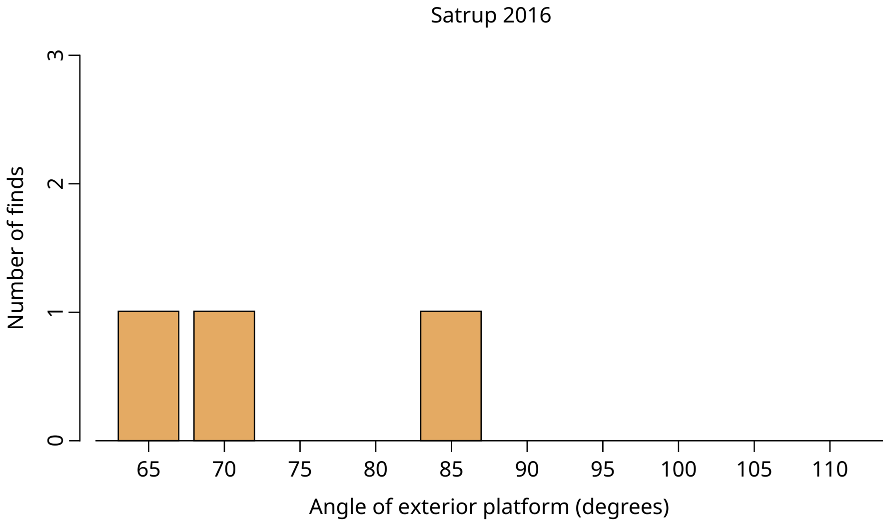
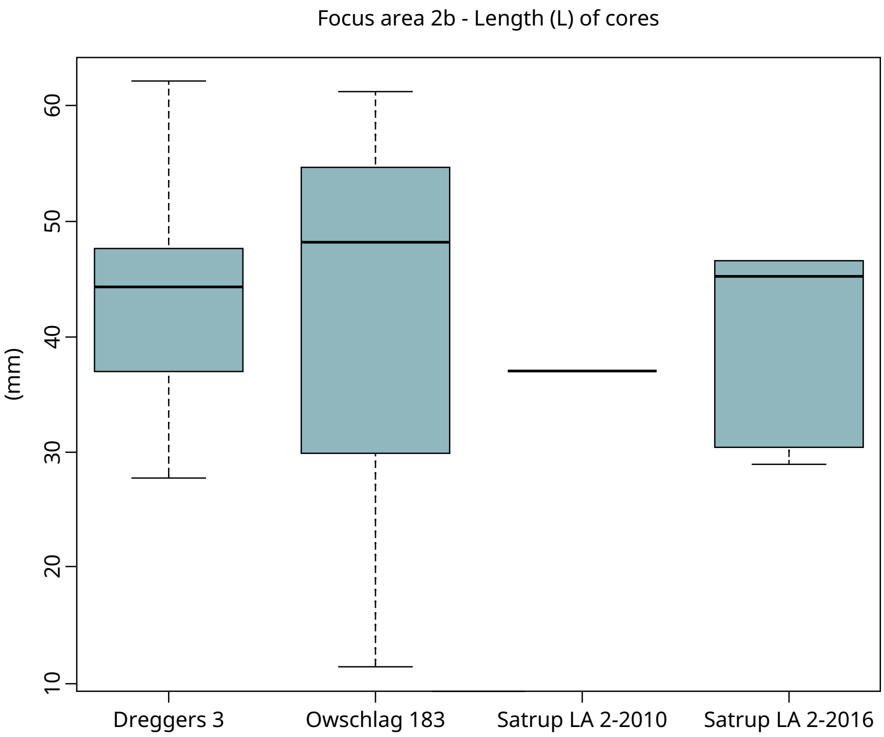


Figure 84 (continued on the next page). Exterior platform angle (EPANG) on recorded cores from focus area 2b, by site. The cores from Satrup LA 2 are also divided between two excavation campaigns in 2010 and 2016.


Satrup 2010
Number of finds
0
1
2
3
65
70
75
80
85
90
95
100
105
110
Angle of exterior platform (degrees)


Satrup 2016
Number of finds
0
1
2
3
65
70
75
80
85
90
95
100
105
110
Angle of exterior platform (degrees)



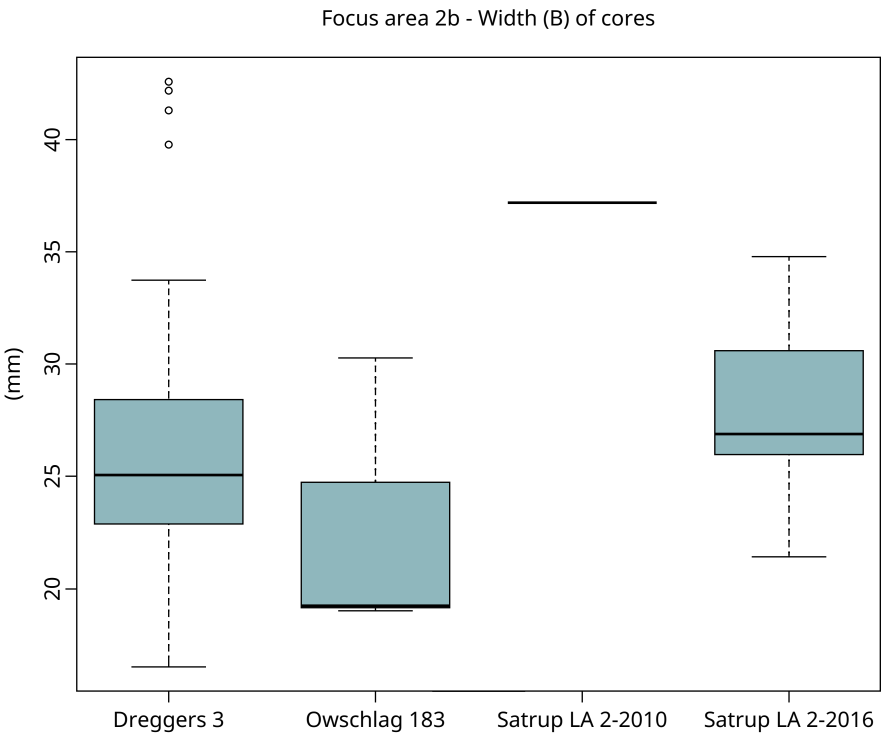
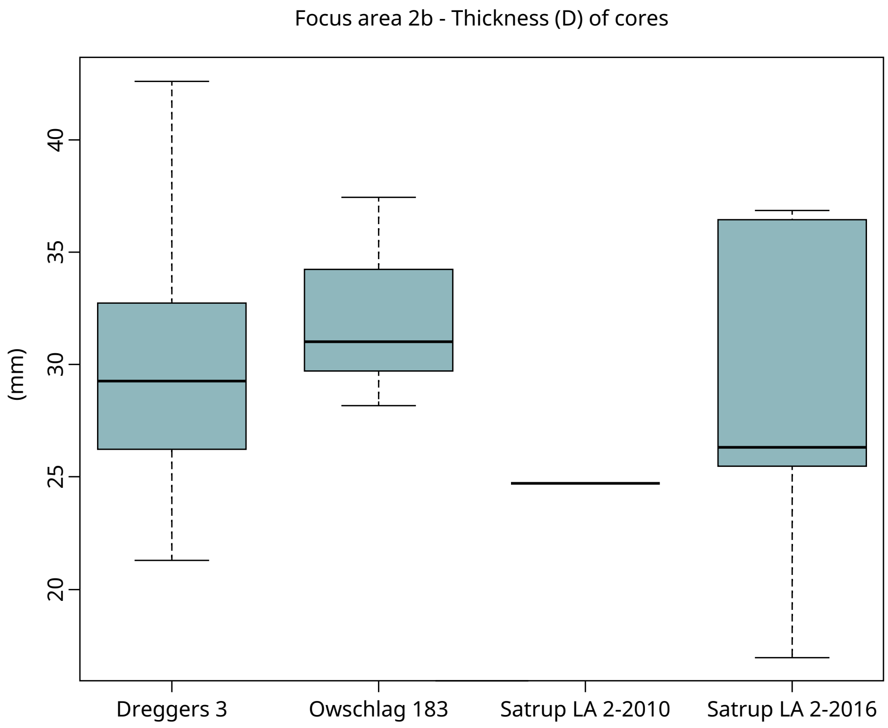


Figure 85 (continued on the following page). Boxplots of core height (L), width (B) and thickness (D) measured in millimetres within focus area 2b, by site. Mean values and interquartile ranges are shown in Table 40.

viations of the measurements indicate that especially the values that represent length of the core (D) show more variety. However, the standard deviations for the measurements from Owschlag also show that core height (L) is characterised by a larger variety. However, this high standard deviation is likely a result of the small number of cores (n=3).



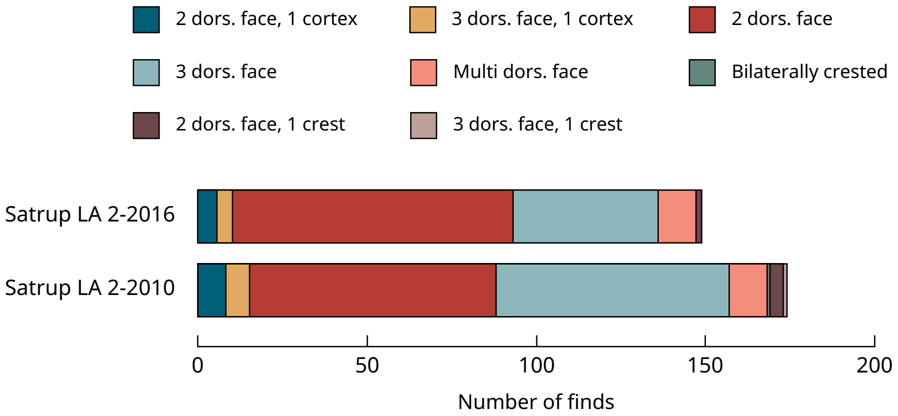


Figure 86. Dorsal blade face (DBF) on recorded blades from two excavation campaigns at the site Satrup LA 2.

Dorsal blade face (DBF)

Most of both assemblages from the Satrup site are made up of blades with two or three dorsal blade faces (Fig. 86). In the material from the 2010 campaign, 42% of blades have two dorsal blade faces and 39.7% have three dorsal blade faces. A smaller portion of blades have more than two dorsal blade faces (multiple dorsal blade faces), amounting to 6.3% of the assemblage.

In the 2016 materials, 55.7% of blades have two dorsal faces and 28.9% have three dorsal blade faces. Multiple dorsal faces are present on 7.4% of blades from this campaign.

Only smaller parts of the assemblages show any presence of cortex (8.6% for the 2010 campaign and 6.7% for the 2016 campaign) or crest (3.4% for the 2010 campaign and 1.3% for the 2016 campaign).

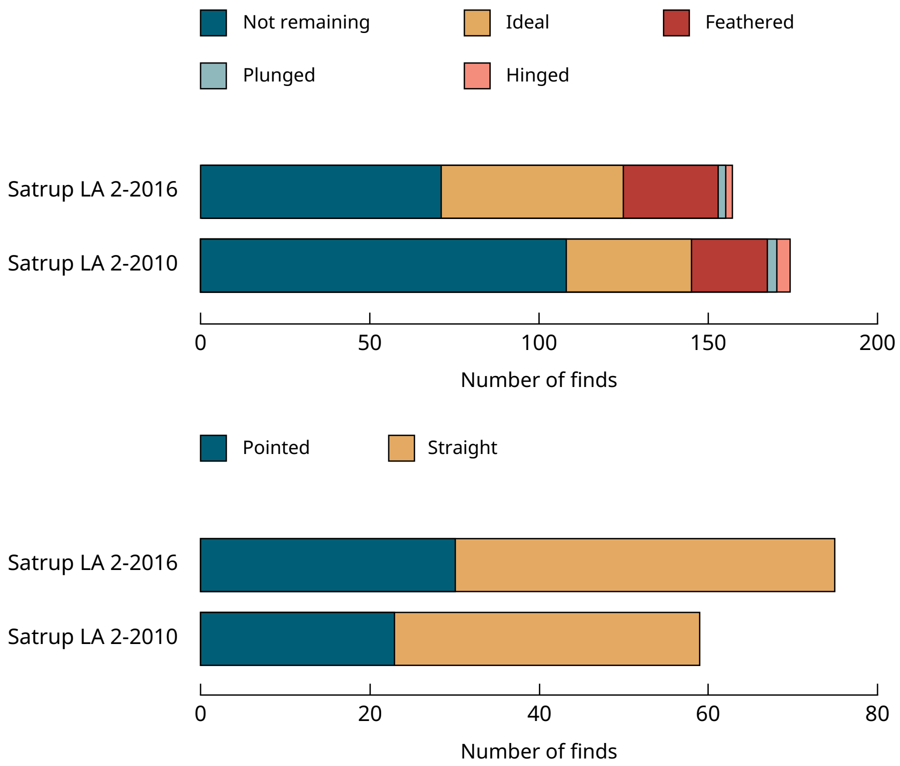


Figure 87. Blade termination 1 (BT1, first bar graph) and blade termination 2 (BT2, second bar graphs) on recorded blades from two excavation campaigns at the site Satrup LA 2.

Blade termination 1 (BT1) and blade termination 2 (BT2)

In the assemblage from the 2010 campaign, most blades do not have a remaining distal end (62.1%). The remaining blades have either ideal terminations (21.3%) or feathered terminations (12.6%). Only small amounts of blades show attribute plunging (1.7%) or hinging (2.3%). The blades with remaining distal ends mostly display straight distal ends (61%), while the remaining part has pointed distal ends (Fig. 87).

In the assemblage from the 2016 campaign, most blades also lack remaining distal ends (45.2%). The rest of the blades have ideal blade termination (34.4%) or feathered terminations (17.8%). A handful of blades show either plunging (1.3%) or hinge breaks (1.3%). Among the complete blades, most have straight ends (60%), while the rest are pointed.

Blade curvature (CURV)

The curvature of blades is almost identical in the two assemblages from Satrup. Even curvature is the most common variation, with 66.7% and 59.6% in the campaigns from 2010 and 2016, respectively. The second most common variation in the two assemblages is “straight”, which is featured on 28.3% of blades from 2010 and 29.8% of blades collected in 2016. Distal curvature is found on 8 blades from each campaign, while the combination of even curvature and ventral belly was found only on 8 blades from the 2010 campaign (Fig. 88).

Blade twist (TWIST)

Blades from the 2010 campaign display less twisting than the blades from the 2016 campaign. The blades excavated in 2010 are twisted in 36.5% of the cases, while blades from the 2016 campaign are twisted in 54.1% of the cases (Fig. 89).

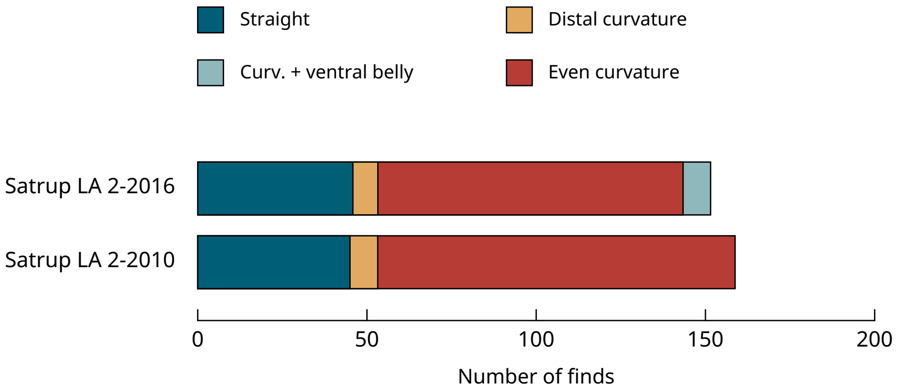


Figure 88. Blade curvature (CURV) on recorded blades from two excavation campaigns at the site Satrup LA 2.

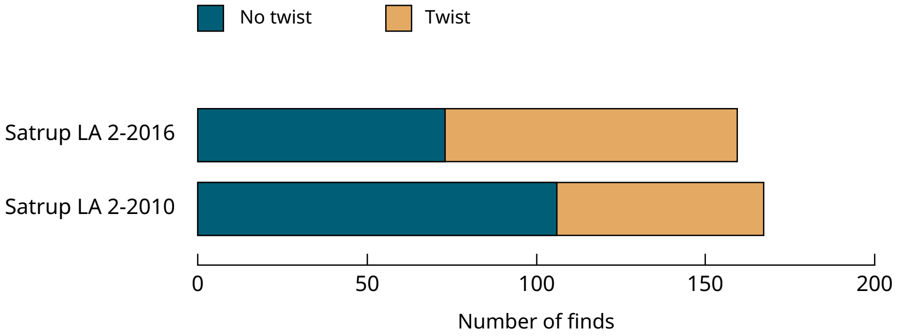


Figure 89. Blade twist (TWIST) on recorded blades from two excavation campaigns at the site Satrup LA 2.

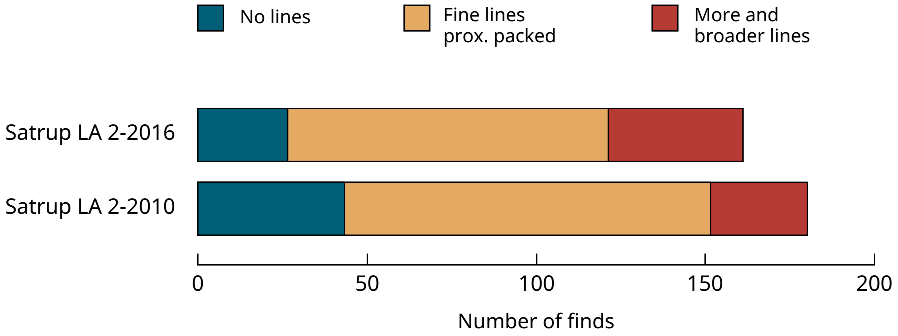


Figure 90. Wallner lines (WN) on recorded blades from two excavation campaigns at the site Satrup LA 2.

Wallner lines (WN)

The variations in Wallner lines are similar in both assemblages from the Satrup site. In both assemblages, most of the blades have fine, proximally dense, Wallner lines. In the materials from the 2010 assemblage, this number amounts to 60% of blades and in the 2016 assemblage, 59% show this attribute variation. Pronounced Wallner lines are more commonly found among the blades from the 2016 campaign, appearing on 24.8% of the blades. The blades collected in 2010 have, in contrast, pronounced Wallner lines on 16.1% of the blades. An absence of Wallner lines is instead more common on the blades found in 2010, appearing on 23.9% of the blades, while the same attribute variation appears only on 16.1% of the blades found in 2016 (Fig. 90).

Blade regularity (REG)

A very similar pattern is seen in both assemblages from Satrup. Most blades are regular, amounting to 73.7% and 77.7% in assemblages from 2010 and 2016,

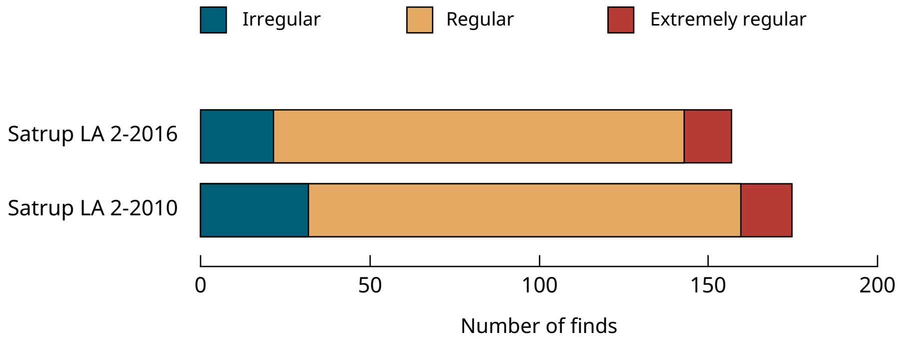


Figure 91. Blade regularity (REG) on recorded blades from two excavation campaigns at the site Satrup LA 2.

respectively. This is followed by irregular blades, which make up 17.7% and 13.4% from 2010 and 2016, respectively. Extremely regular blades make up 8.6% and 8.9% of the assemblages excavated in 2010 and 2016, respectively (Fig. 91).

Platform preparation dorsal (SFPD)

The dorsal platform preparation is done slightly differently within the two assemblages from the site (Fig. 92). In the assemblage from 2010, most blades were prepared using a combination of trimming and abrasion (51.9%), followed by trimming (28.2%), abrasion (13.8%) and no preparation (6.1%).

In the assemblage from 2016, trimming and a combination of trimming and abrasion are almost equally common, with trimming appearing on 39.5% and trimming and abrasion appearing on 38.7% of the blades. The remaining portion of the assemblage is almost equally divided between abrasion (11.3%) and a lack of preparation (10.5%).

Platform preservation (SFPE)

The two assemblages from the Satrup site show almost identical patterns. The most common platform preservation variation in both datasets is the presence of smooth platforms (79.8% and 72.5% in the 2010 and 2016 assemblages, respectively). This is followed by the presence of crushed platforms in both assemblages (9.6% and 12.5% in 2010 and 2016, respectively). Any sort of faceting appears on 8.4% and 12.5% of the 2010 and 2016 assemblages, respectively. The presence of cortex on the platform exists only on a few finds in the two materials (Fig. 93).

Conus formation (KE)

Conus formation on the blade butts is rather uncommon in both datasets. In the 2010 assemblage, 76.9% of blades lack conus formation. In the remaining portion of blades in this dataset, there is existing conus formation on 19.2% of the blades. In the assemblage from 2016, 28.3% have conus formations. Only a few blades from each of the two assemblages have conus formation visible only on the platform or have a double conus formation (Fig. 94).

Lip (SL)

The patterns relating to lip formation are similar in the two datasets. The most common attribute variation is the presence of a diffuse lip, which is seen on 69.2% of the blades from 2010 and 59.1% of the blades from 2016. The lack of a lip is found on 25.8% of the blades from 2010 and 37.4% of the blades from 2016. Smaller portions from each assemblage have pronounced lips, with 5% from 2010 and 3.5% from 2016 (Fig. 95).

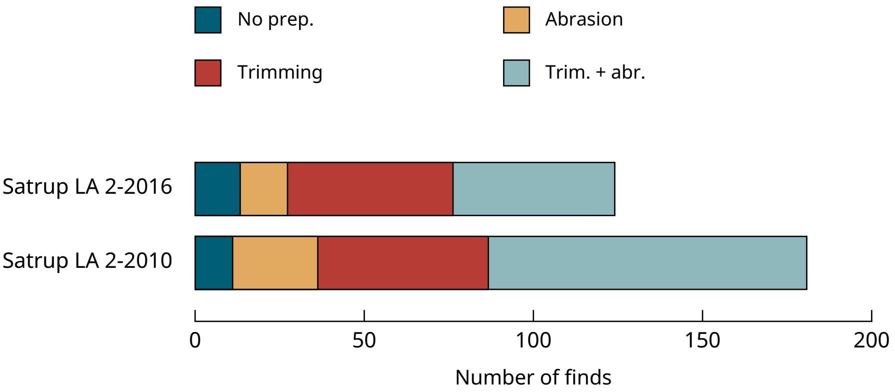


Figure 92. Platform preparation dorsal (SFPD) on recorded blades from two excavation campaigns at the site Satrup LA 2.

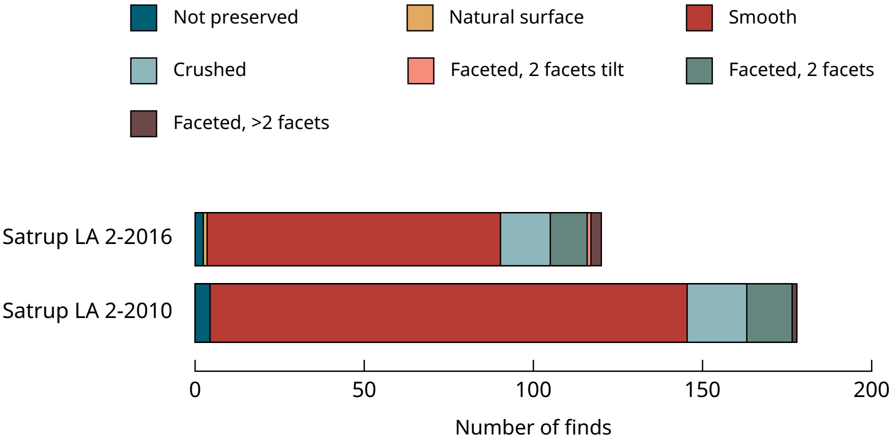


Figure 93. Platform preservation (SFPE) on recorded blades from two excavation campaigns at the site Satrup LA 2.

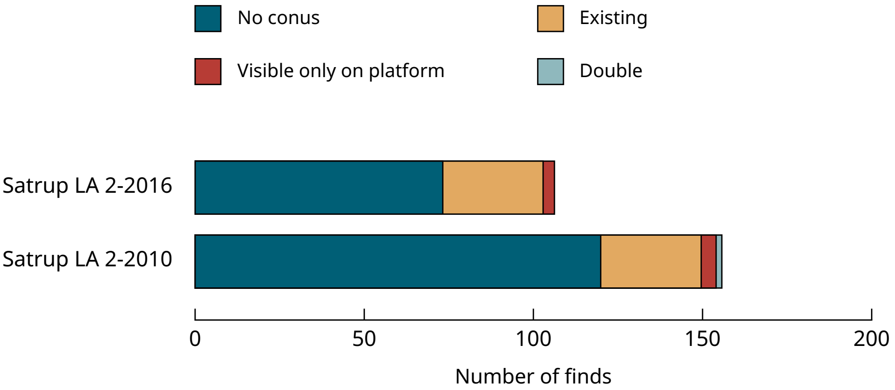


Figure 94. Conus formation (KE) on recorded blades from two excavation campaigns at the site Satrup LA 2.

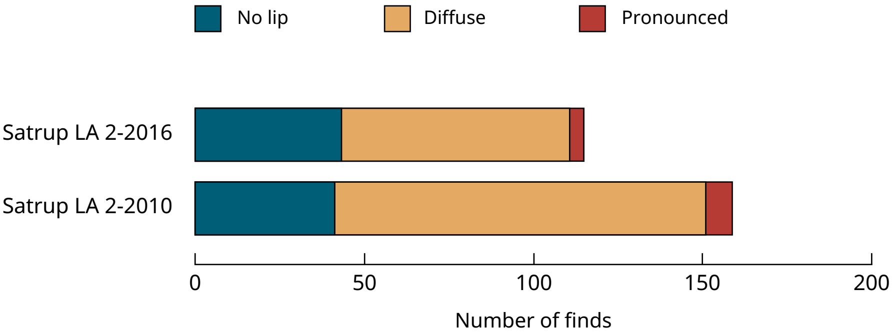


Figure 95. Lip (SL) on recorded blades from two excavation campaigns at the site Satrup LA 2.

Focus area 2b – Satrup LA 2 – 2010

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Butt width (SFRD)	1	3.1	4.5	4.701	5.5	26.9	2.60774	163
Butt thickness (SFRK)	0.5	1.1	1.4	1.558	1.975	4.5	0.694587	162

Focus area 2b – Satrup LA 2 – 2016

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Butt width (SFRD)	0.9	2.1	3.5	3.615	4.7	9.5	1.667778	106
Butt thickness (SFRK)	0.5	0.8	1.1	1.306	1.7	3.2	0.658545	106

Table 41. Platform width (SFRD) and platform thickness (SFRK) from two excavation campaigns at the site Satrup LA 2.

Focus area 2b – Satrup LA 2 – 2010

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Blade length (L)	17.4	28	34.5	**37.61**	45.83	67.5	12.21684	66
Blade width (B)	5.4	10.7	13.65	**13.79**	16.9	25.3	3.920671	184
Blade thickness (D)	1.2	2.475	3.3	**3.346**	4	9.3	1.219642	184

Focus area 2b – Satrup LA 2 – 2016

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Blade length (L)	5.6	24.6	28.1	*32.17*	38.4	62.5	11.25829	65
Blade width (B)	4.8	7	8.35	*9.467*	10.075	22.2	3.777463	158
Blade thickness (D)	1.1	1.9	2.4	*2.742*	3.3	8.9	1.222205	158

Table 42. Blade sizes in focus areas 2b. The largest mean values are marked in bold and the smallest values are marked in italic.

Platform width (SFRD) and platform thickness (SFRK)

The details of blade butt sizes from the focus area can be found in Table 41. The size of blade butts in the two assemblages from Satrup are rather similar. The blades from 2010 show slightly larger means for butt width and thickness than the blades found in 2016. They also have a higher standard deviation relating to both measurements, indicating slightly more variety within that assemblage. However, these differences are small and the two assemblages are rather homogenous.

Blade sizes – Length (L), width (B) and thickness (D)

The same trend, as with the blade butts, can be observed in the data regarding length, width and thickness of the blades (Fig. 96). The details of blade sizes of the blades from the focus area can be found in Table 42. In short, the blades found during the 2010 excavations are slightly larger in length, width and thickness than the blades found in 2016.

The standard deviations are also slightly larger in the 2010 dataset, indicating more variety in size within the assemblage than in the 2016 assemblage. Nonetheless, these differences are slight and largely indicate that the blade sizes in the two assemblages are rather homogenous.

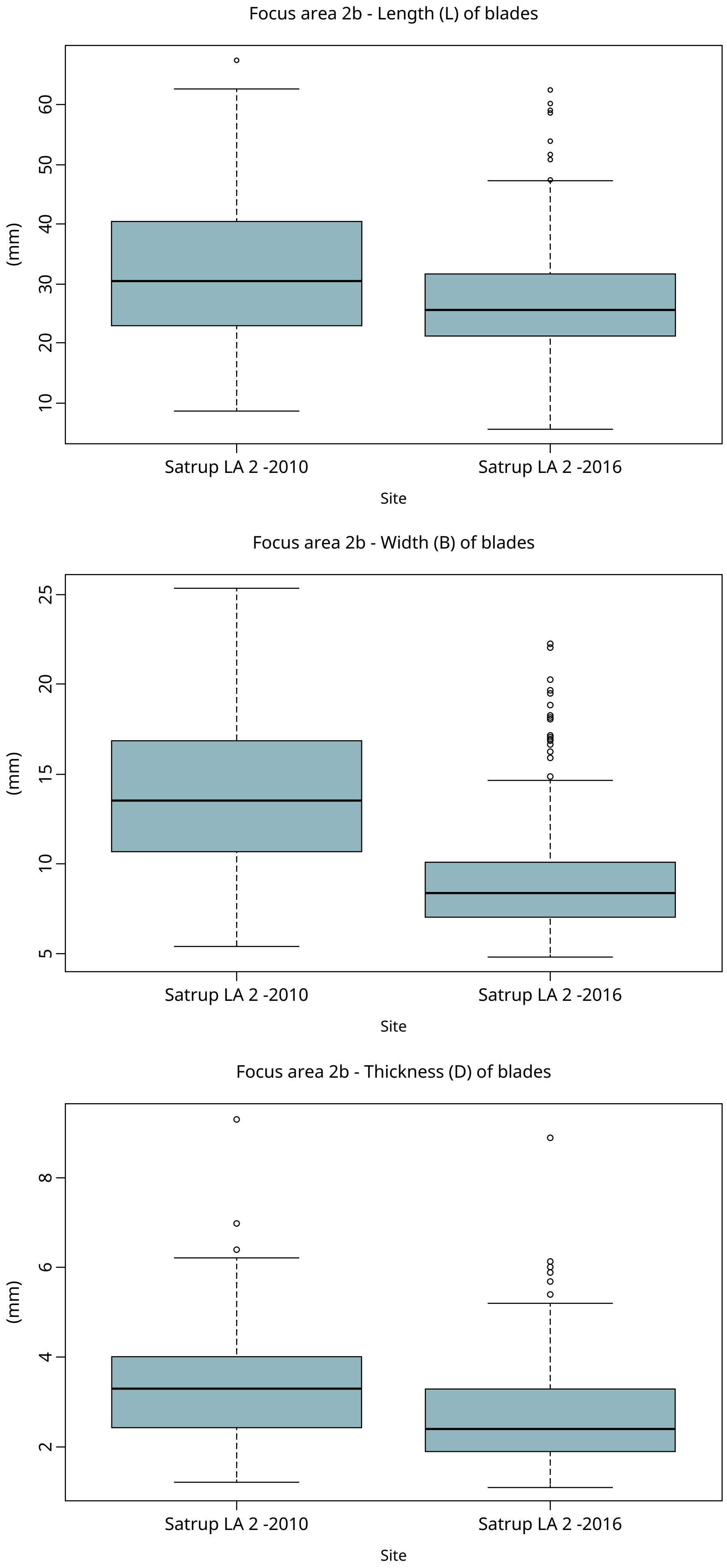


Figure 96. Boxplots of blade length (L), width (B) and thickness (D) measured in millimetres from two excavation campaigns at the site Satrup LA 2. Mean values and interquartile ranges are shown in Table 42.

Summary for focus area 2b

The cores from focus area 2b commonly have a single platform, a single core front and are most often made from nodules. Core rejuvenation is mainly done through frontal rejuvenation. Platform morphologies mainly include smooth platforms but faceting/partial faceting does occur. The backs of the cores are most often shaped by striking away multiple flakes, or left unworked. The sides of the cores often have flake negatives, with or without side platform preparation. Dorsal preparation often appears in the form of trimming. The angle between the core front and the platform commonly ranges between 80-95 degrees. Core sizes appear to be rather homogenous across the different sites, although varying assemblage sizes complicate comparisons. The distal ends of the blades are often not remaining (broken), followed by ideal and feathered ends. Most blades from the site have an even curvature, followed by those with straight curvature. Only some single blades display distal curvature. Around 45% of the blades from the area are twisted. Most blades have fine Wallner lines, followed by equal amounts of no lines and broad lines. Most blades from each site are regular, followed by irregular blades. Platform preparation was done by means of a combination of trimming and abrasion, followed by trimming and subsequent abrasion. A large majority of the blades have smooth platforms with only a few examples of faceted platforms. Most blades show no signs of conus formation. Most blades also have a diffuse lip, followed by no lip. The butt sizes from the two excavation campaigns are rather similar, only with slightly larger blade butts in the assemblage excavated in 2010. The same pattern is also seen in the blade sizes in general. Consequently, the rather similar characteristics of striking features as well the regularity and repeatedly occurring platform preparation lead to the conclusion that the blades from F2a were mainly produced during the main blade production phase.

6.1.1.4 Focus area 3 – Southeastern Norway

The blades from focus area 3 come from the sites Krøgenes D2, Stene terrasse, Stokke/Polland 8 and Vallermyrene. There were no blades recorded from the site Lokalitet 3 (Halden project) since the site has been interpreted as a mixed site with a long chronology stretching over the entire Nøstvet phase of the Mesolithic (Melvold 2006).

Platform design (KSFA) and platform use (KSFN)

The cores in focus area 3 commonly have one single platform. Only the largest assemblage, Lokalitet 3, contains a core with a second platform, which was used subsequent to the first one (Fig. 97).

Core front design (KAAN)

Cores in the focus area are homogenous with respect to their core front design. Cores generally have one single core front, except for two examples from the Lokalitet 3 assemblage, which have an additional front. These core fronts are placed either on opposite sides of the platform (1/46 examples) or independent of the first platform (1/46 examples) (Fig. 98).

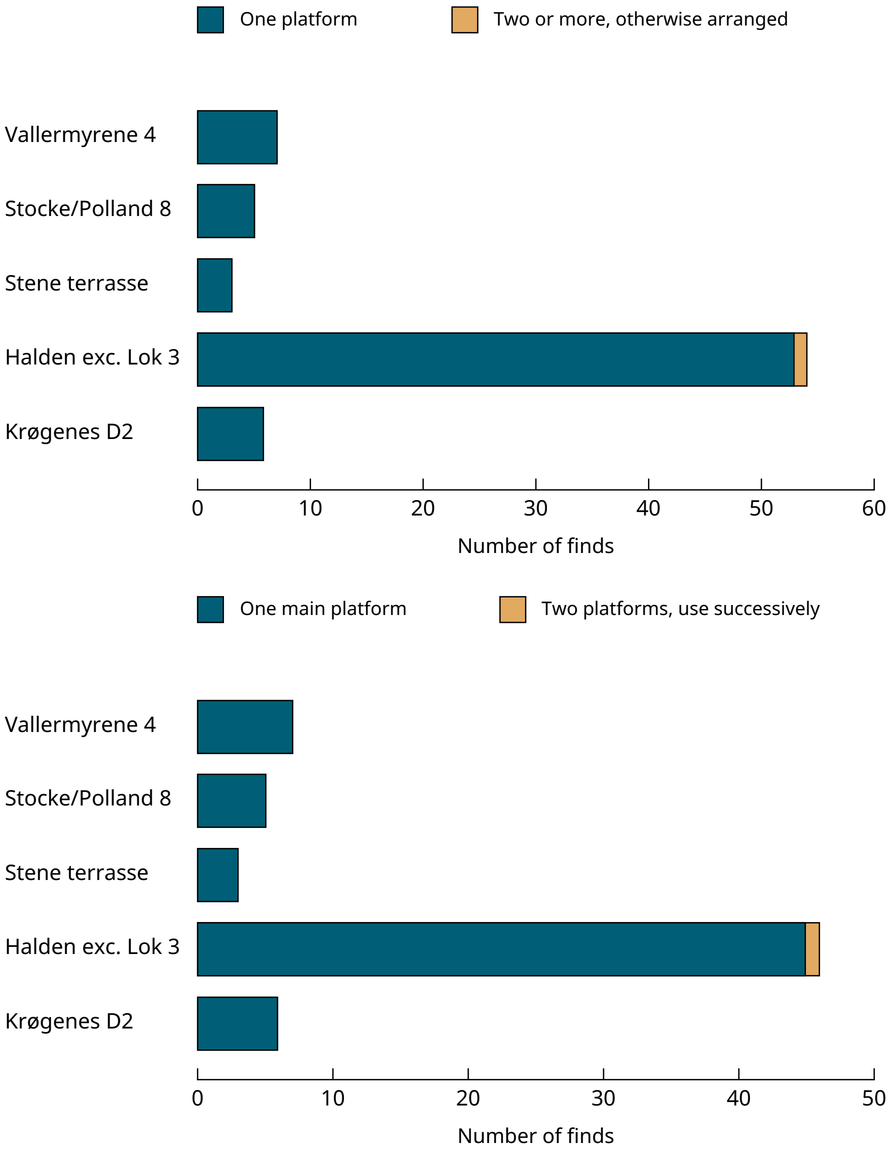


Figure 97. Platform design (KSFA, first bar graph) and platform use (KSFN, second bar graph) of recorded cores from focus area 3, by site.

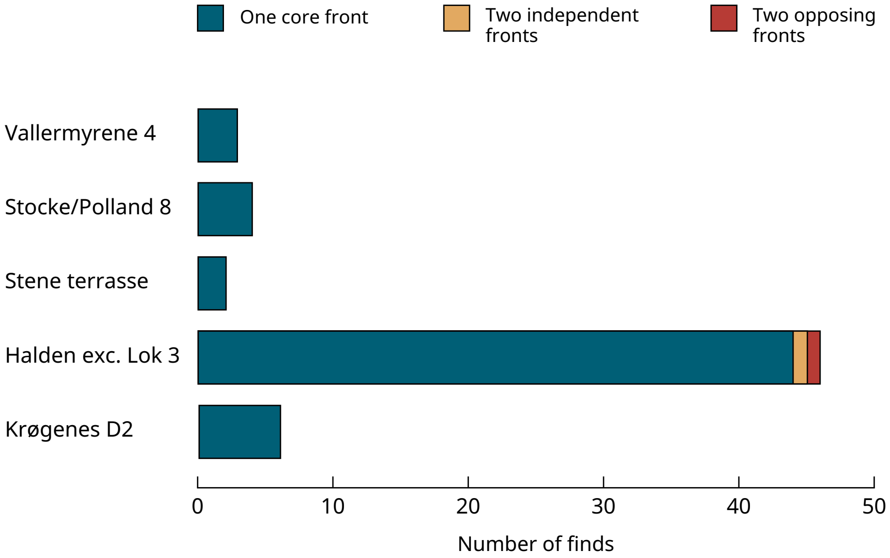


Figure 98. Core front design (KAAN) on recorded cores from focus area 3, by site.

	Cortex (1)	Flake negatives (3)	One flake negative (4)	Cortex + lat edge prep. (6)	Flake negatives + lat edge prep. (7)	One flake negative + lat edge prep. (8)	Number of finds total
Krøgenes KS1	2	2	1	0	1	0	6
Krøgenes KS2	1	3	0	1	1	0	6
Halden, Lok 3 KS1	2 (4.7%)	19 (44.2%)	7 (16.3%)	0 (0%)	14 (32.6%)	1 (2.3%)	43 (100.1%)
Halden, Lok 3 KS2	1 (2.3%)	16 (37.2%)	5 (11.6%)	1 (2.3%)	19 (44.2%)	1 (2.3%)	43 (99.9%)
Stene terrasse KS1	1	1	0	0	1	0	3
Stene terrasse KS2	0	0	0	0	2	1	3
Stokke/Polland KS1	0	3	0	0	0	0	3
Stokke/Polland KS2	0	2	1	0	0	0	3
Vallermyrene KS1	0	1	0	0	6	0	7
Vallermyrene KS2	1	3	0	0	3	0	7

Table 43. Core side preparation in focus area 3. Percentages were only calculated for Lokalitet 3. The other assemblages were considered too small for a relevant comparison (<10 finds).

Handle core on flake (HCF)

Most of the cores were made from nodules rather than flakes. The Vallermyrene and Stene terrasse assemblages exclusively contain cores made from nodules. The Krøgenes and Stokke/Polland 8 assemblages contain 2 and 1 core(s) made from flakes, respectively. Among the cores from Lokalitet 3, two were made from flakes (3.7%) (Fig. 99).

Core back (KR)

The backs of the cores were mainly prepared by the removal of multiple flakes. All cores from Vallermyrene and Stene terrasse have flake negatives. Stokke/Polland and Krøgenes have some single examples of unprepared (cortex-covered) backs, while 22% of the cores from Lokalitet were left unprepared (Fig. 100).

Core side 1 (KS1) and core side 2 (KS2)

Comparisons between the different sites in this focus area are difficult, since all but one site have less than 10 recorded cores (see details in Table 43; Fig. 101). Nevertheless, the assemblages from the different sites have very similar patterns of core side preparation. Among the cores from each site, the most common side preparation is the removal of multiple flakes (3) or removal of flakes in combination with lateral edge preparation (7), followed by no preparation/cortex (1). The remaining attribute variations (4, 6 and 8) are only represented by a few cores.

Platform morphology (PMORPH)

Platform morphology is rather varied in the focus area. The cores from Lokalitet 3 mainly have smooth platforms (74%) followed by faceted platforms (22%) and partially faceted platforms (4%). In the assemblage from Vallermyrene,

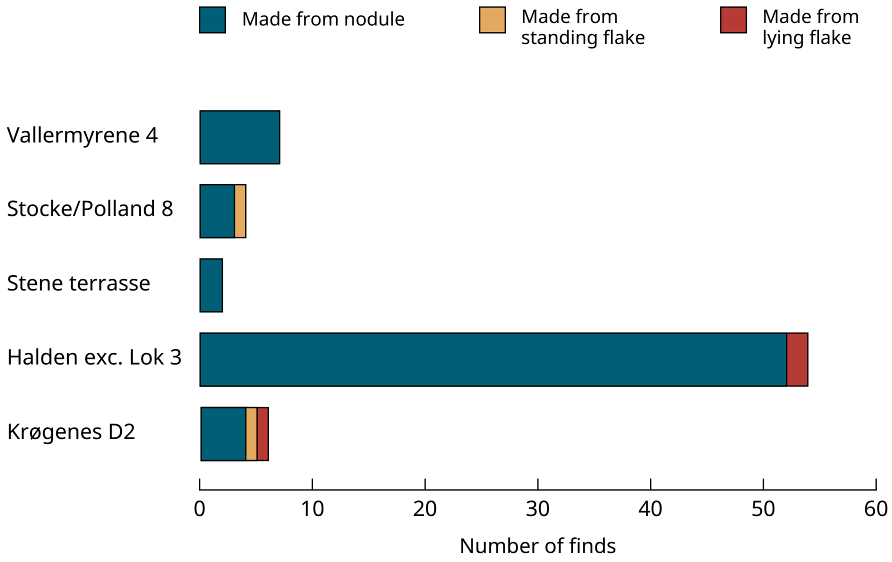


Figure 99. Handle core on flake (HCF) among recorded cores from focus area 3, by site.

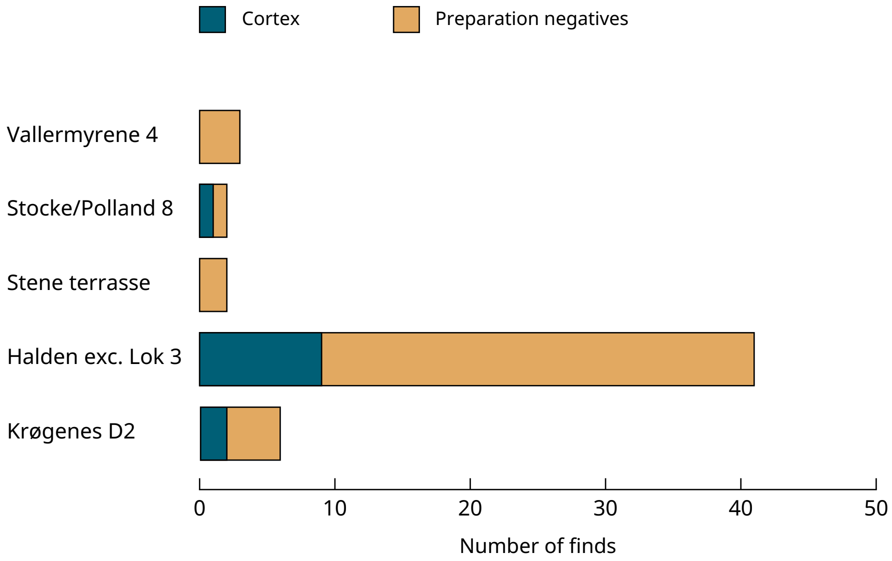


Figure 100. Core back (KR) on recorded cores from focus area 3, by site.

smooth platforms form a slight majority (55.6%), followed by equal amounts of faceted (22.2%) and partially faceted (22.2%) platforms. Out of the three cores from Stene terrasse, two have smooth platforms and one has a faceted platform.

In the assemblages from Stokke/Polland 8 and Krøgenes D2, all platform morphologies are represented with 1-2 cores (Fig. 102).

Platform preparation dorsal (PPCD)

Trimming is the most common dorsal preparation in the focus area. In the assemblage from Lokalitet 3, trimming is present on 87% of cores. This is followed by a lack of preparation (8.7%) and single cores that show traces of abrasion or trimming/abrasion in combination.

The cores from Vallermyrene and Stene terrasse exclusively have trimming. Most cores from the Krøgenes site show trimming. Only in the Stokke/Polland assemblage is there a majority of cores that lack any dorsal preparation (Fig. 103).

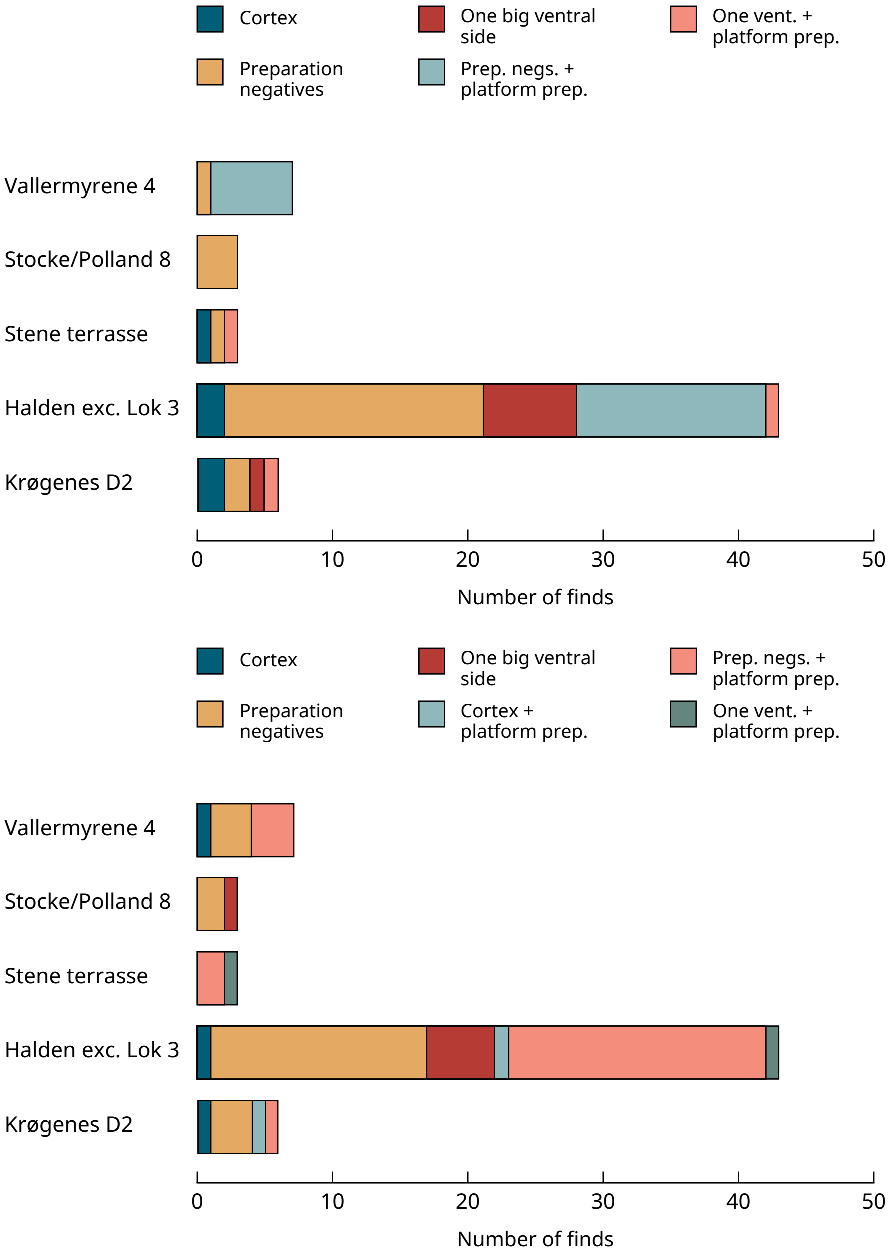


Figure 101. Core side 1 (KS1, first bar graph) and core side 2 (KS2, second bar graph) on recorded cores from focus area 3, by site.

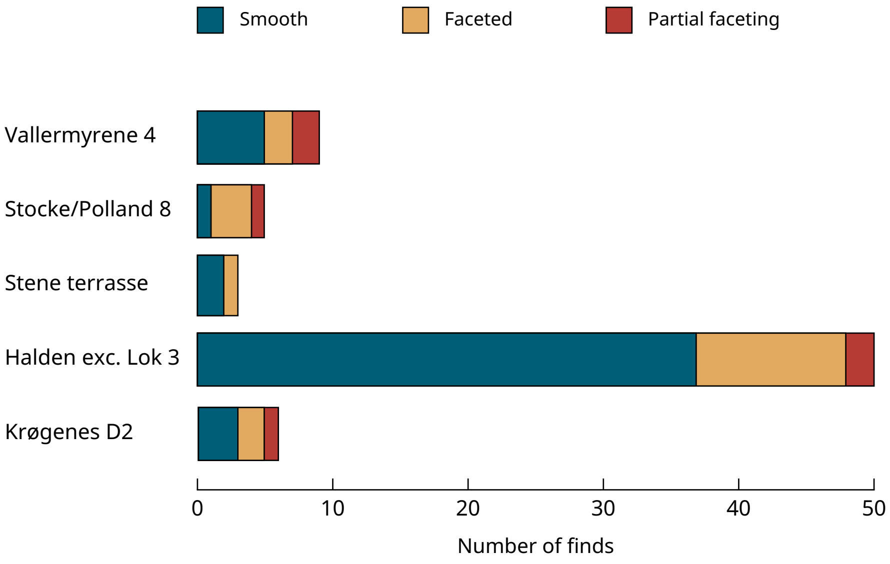


Figure 102. Platform morphology (PMORPH) on recorded cores from focus area 3, by site.

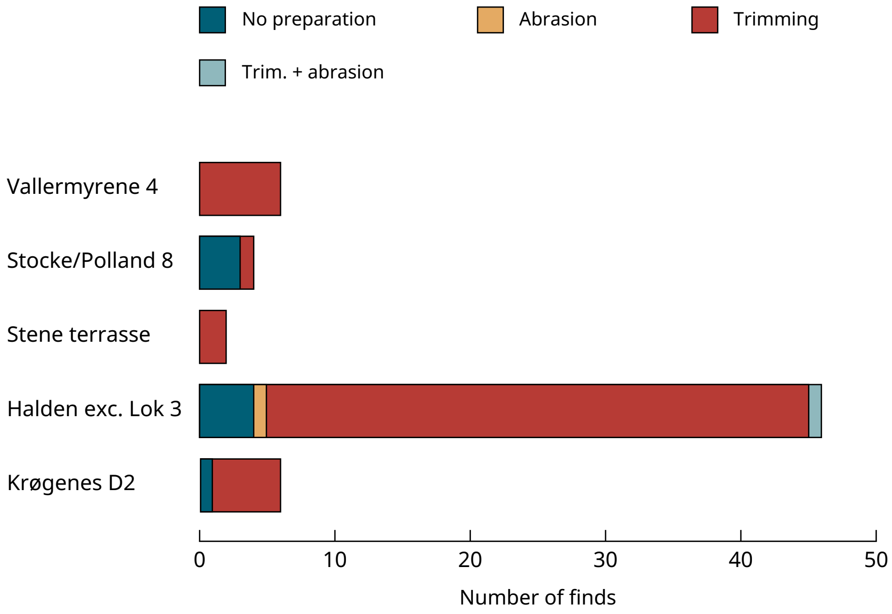


Figure 103. Platform preparation dorsal (PPCD) on recorded cores from focus area 3, by site.

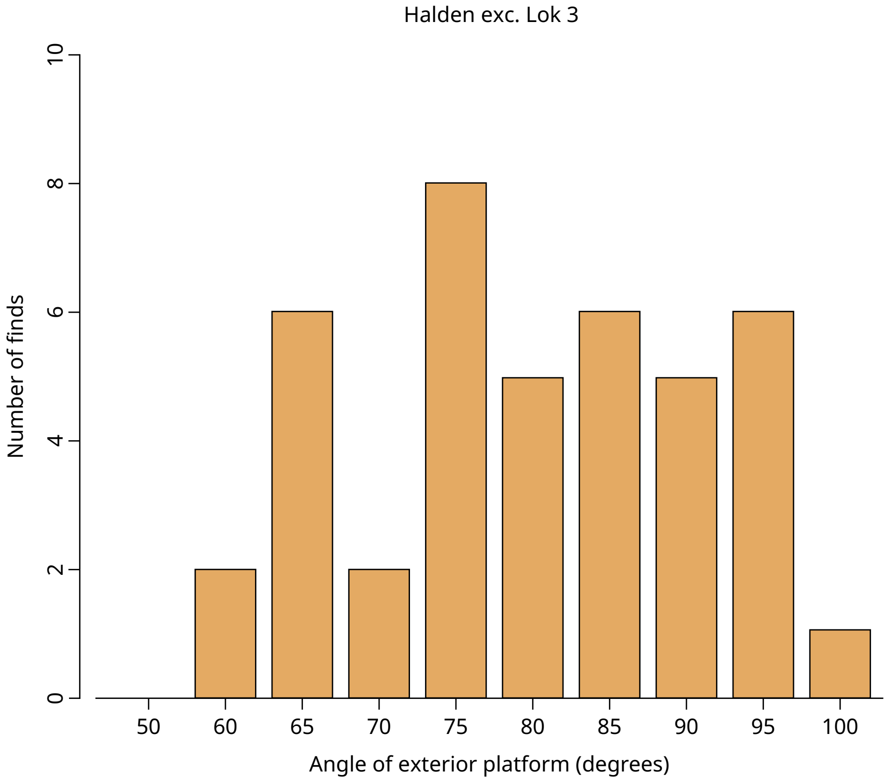
Exterior platform angle (EPANG)

The exterior platform angles from Lokalitet 3 are highly varied and range from 60 to 100 degrees, with most cores almost equally distributed in the categories 65, 75, 80, 85, 90 and 95 degrees. The most common exterior platform angle is 75 degrees (19.2%).

The few cores in the Krøgenes assemblage are represented by angles of 70, 85 and 95 degrees. The cores from Stene terrasse have angles of 85 and 90 degrees. The cores from Stokke/Polland have angles of 65, 75, 85 and 95 degrees. Finally, the Vallermyrene assemblage contains cores with angles of 50, 65, 75 and 80 degrees (Fig. 104).

Core sizes (L, B and D)

The sizes of the cores are rather homogenous within the focus area (Table 44; Fig. 105), with an average core height of ca. 22-26 mm and an average core width of ca. 18.5-23 mm. The average core length varies more, seen both in the average ranging from 28-43 mm as well as in the high standard deviation for each site.



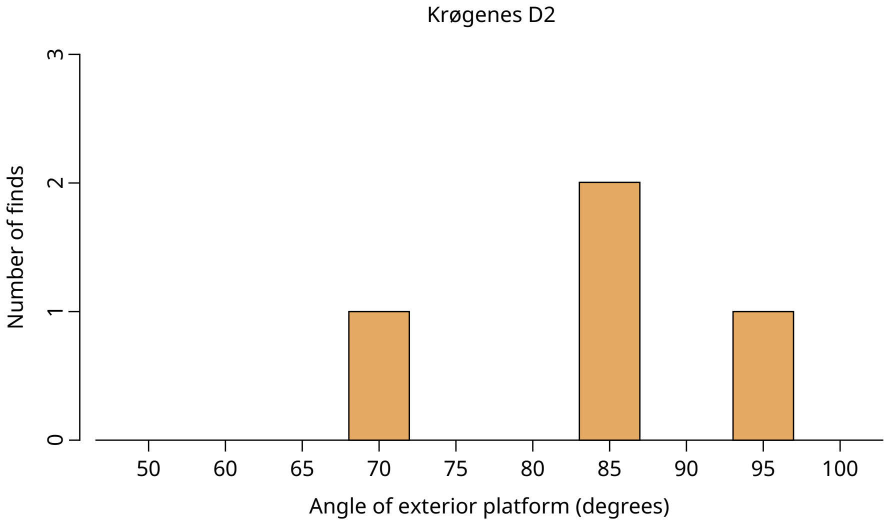
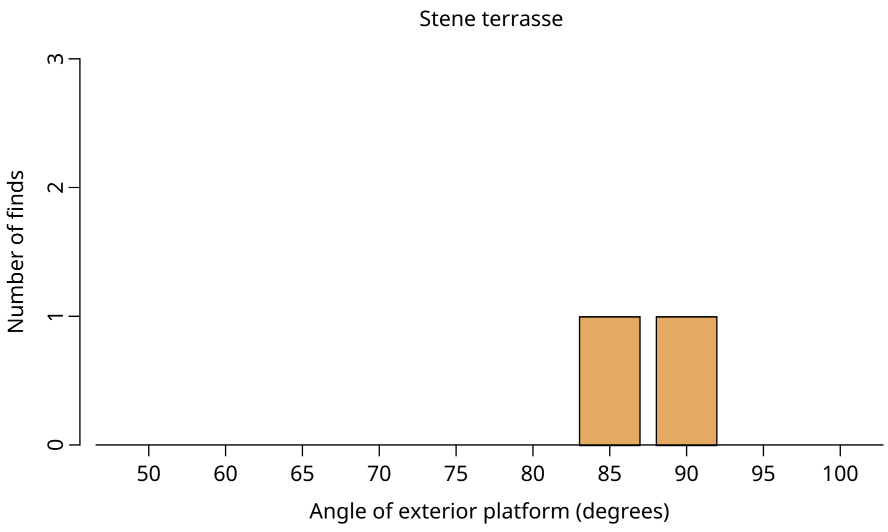
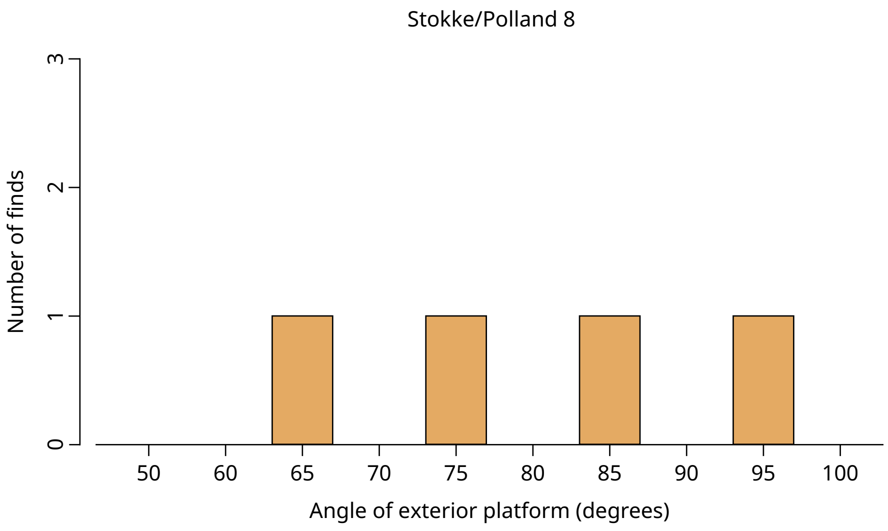
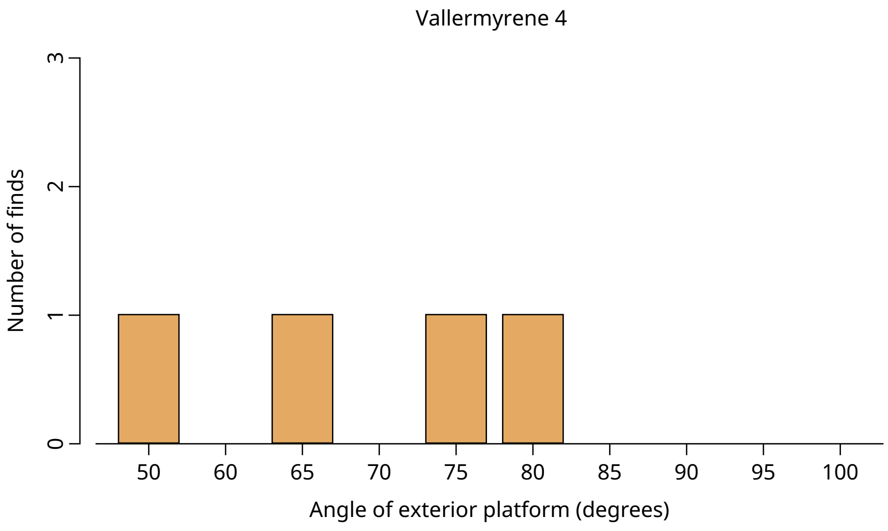


Figure 104 (continued on following page). Exterior platform angle (EPANG) on recorded cores from focus area 3, by site.


Stene terrasse
Number of finds
0
1
2
3
50
60
65
70
75
80
85
90
95
100
Angle of exterior platform (degrees)


Stokke/Polland 8
Number of finds
0
1
2
3
50
60
65
70
75
80
85
90
95
100
Angle of exterior platform (degrees)


Vallermyrene 4
Number of finds
0
1
2
3
50
60
65
70
75
80
85
90
95
100
Angle of exterior platform (degrees)

Focus area 3 – Vallermyrene 4

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	14	20.05	29.9	**26.14**	33.3	34.8	7.996908	11
Core width (B)	13.8	18.75	22.4	22.55	25.9	31.9	5.278326	11
Core length (D)	5.8	15	35.35	36.56	44.88	101.8	28.31153	10

Focus area 3 – Krøgenes D2

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	19.4	20.1	21.35	25.65	31.52	37.2	8.040833	6
Core width (B)	13.6	15.18	18.1	19.05	19.38	30.5	6.089581	6
Core length (D)	25	30.52	33.2	35.3	38.2	50.9	9.024411	6

Focus area 3 – Stokke/Polland 8

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	22.5	23.4	24.3	24.27	25.15	26	1.750238	3
Core width (B)	15.2	17.8	20.2	20.16	20.9	26.7	4.286374	5
Core length (D)	29.6	31	43.7	39.96	47.2	48.3	8.994054	5

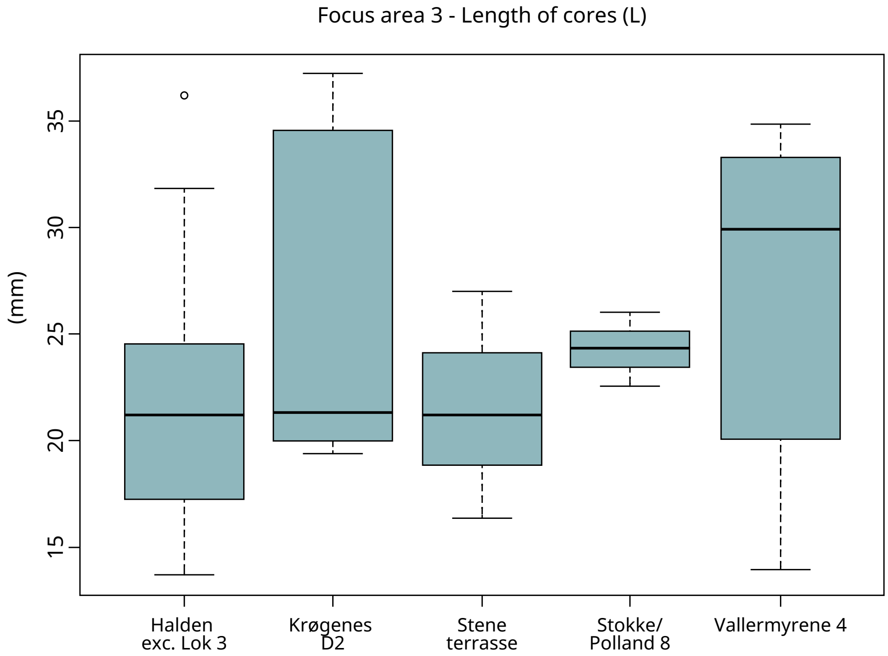
Focus area 3 – Stene terrasse

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	16.4	18.8	21.2	21.53	24.1	27	5.307856	3
Core width (B)	22	22.25	22.5	**22.83**	23.25	24	1.040833	3
Core length (D)	34.4	35.2	36	**42.53**	46.6	57.2	12.72687	3

Focus area 3 – Lokalitet 3, Halden excavations

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Core height (L)	13.7	17.23	21.2	*21.49*	24.57	36.2	5.207645	54
Core width (B)	9.8	15.8	18	*18.46*	20.9	39.1	4.708844	53
Core length (D)	3.1	17.45	24.15	*28.16*	36.77	70.2	15.51791	54

Table 44. Core sizes in focus area 3, by site. The largest mean values are marked in bold and the smallest values are marked in italic.



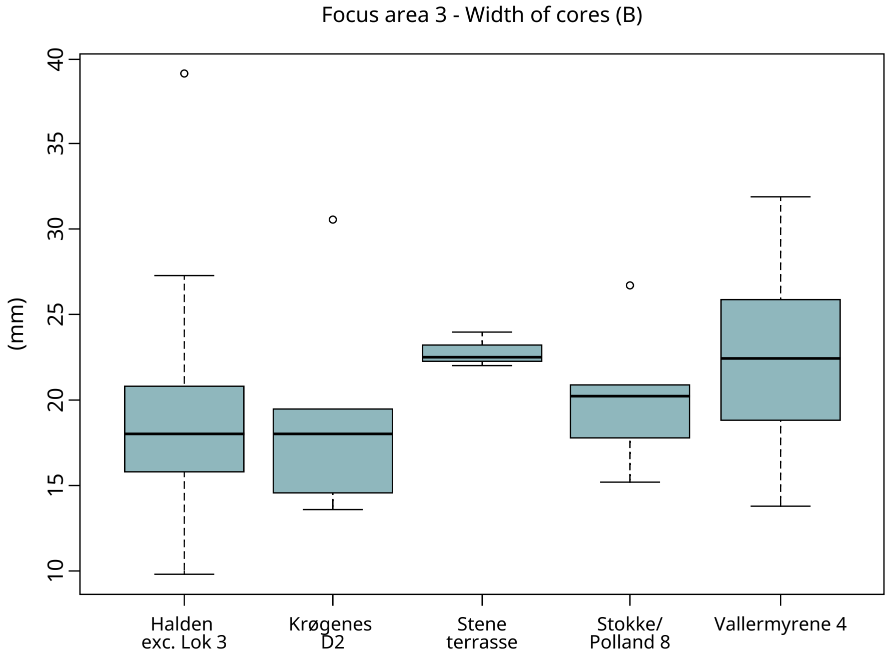


Figure 105 (continued on following page). Boxplots of core height (L), width (B) and thickness (D) measured in millimetres within focus area 3, by site. Mean values and interquartile ranges are shown in Table 44.

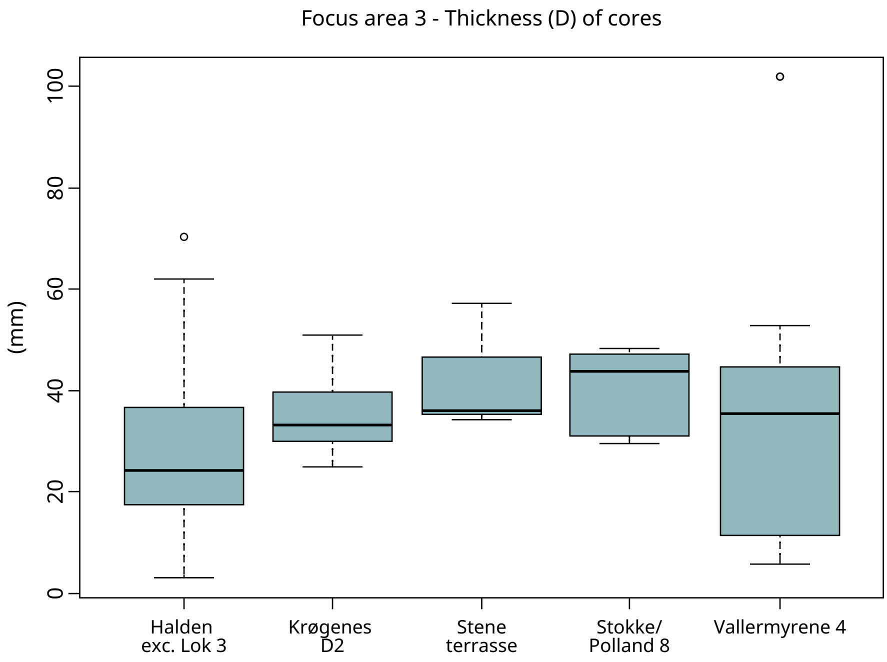


Figure 105 (continued). Boxplots of core height (L), width (B) and thickness (D) measured in millimetres within focus area 3, by site. Mean values and interquartile ranges are shown in Table 44.

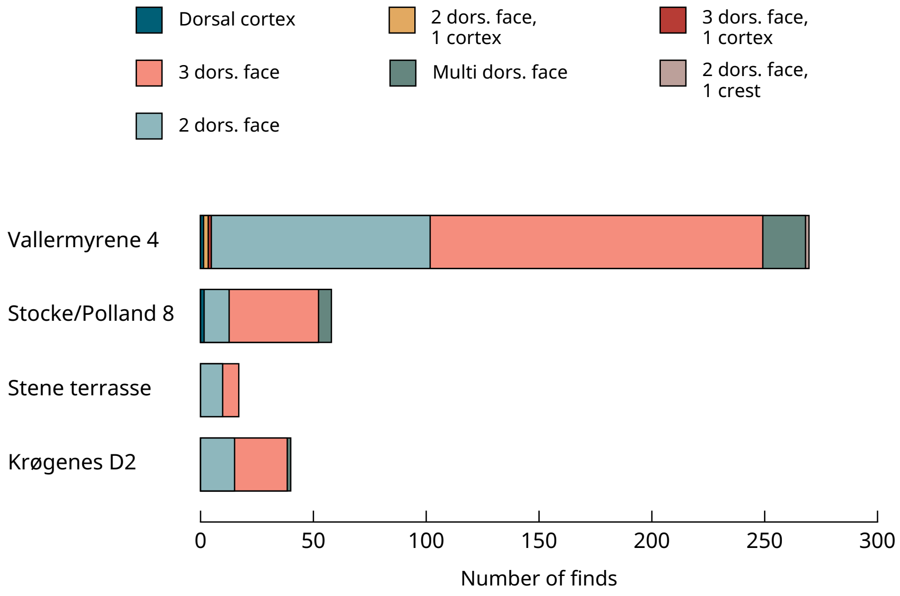


Figure 106. Dorsal blade face (DBF) on recorded blades from focus area 3, by site.

Dorsal blade face (DBF)

Most of the blades in the assemblages from focus area 3 have either two or three dorsal blade faces. The blades from the Krøgenes D2 most commonly have three dorsal blade faces (57.5%), followed by two dorsal blade faces (40%). Only one single blade (2.5% of the assemblage) has more than two faces (listed as multiple).

A similar trend can be found in the assemblage from Stokke/Polland 8, which contains mostly blades with three dorsal blade faces (69%), followed by those with two dorsal blade faces (20.7%). A few blades have multiple dorsal blade faces (8.6%), while one blade (1.7%) has remains of a cortex on the dorsal side.

The same trends are seen in the Vallermyrene assemblage, which mainly contains blades with three dorsal blade faces (54.8%), followed by two dorsal

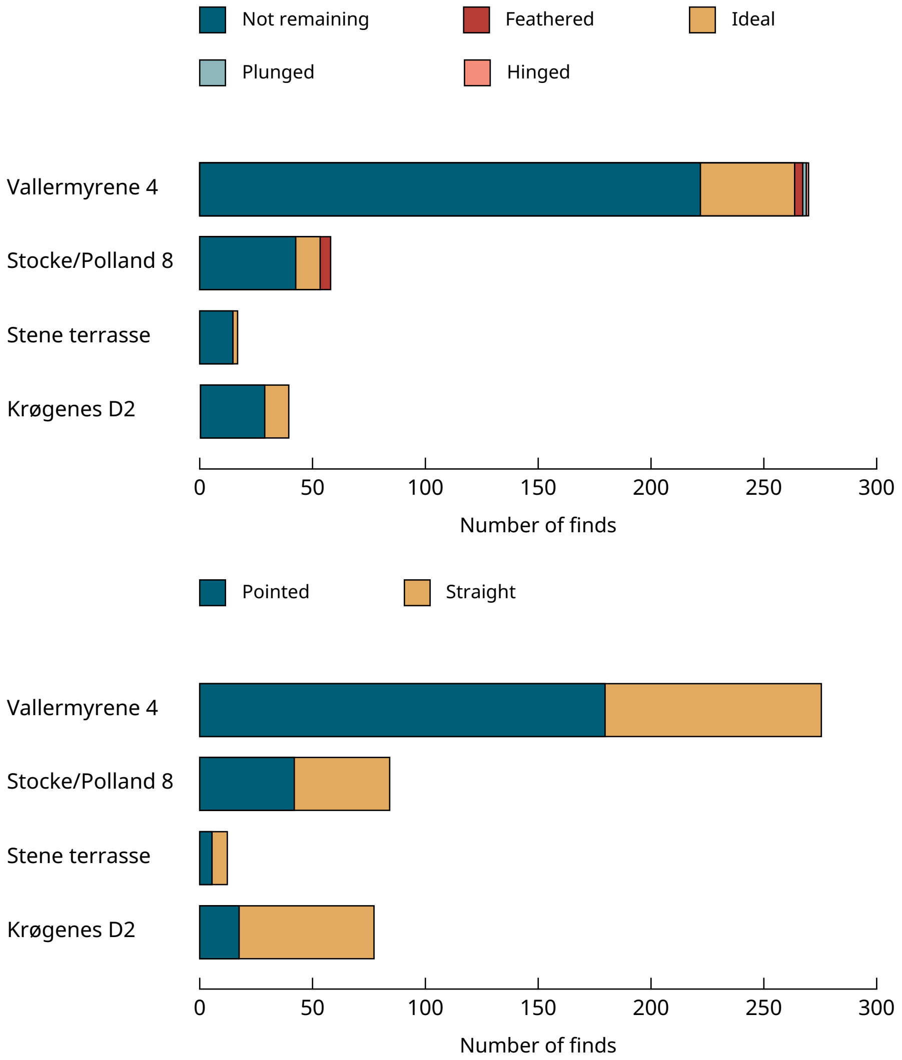


Figure 107. Blade termination 1 (BT1, first bar graph) and blade termination 2 (BT2, second bar graph) on recorded blades from focus area 3, by site.

blade faces (36.3%), multi-dorsal blade faces (7%) and dorsal faces with remaining cortex (1.5%). One single blade shows the remains of a crest.

Contrary to the other sites in the focus area, on Stene terrasse most blades have two dorsal blade faces (58.8%), while the rest of the blades have three dorsal blade faces (41.2%). No cortex or cresting was found on these blades (Fig. 106). This is also the smallest dataset in the focus area, which creates further risks of sample size effects (Grayson 1981) relating to these blades.

Blade termination 1 (BT1) and blade termination 2 (BT2)

The manner of blade termination within the focus area is rather homogenous. Each site presents many blades with non-remaining distal ends (Fig. 107). In the Krøgenes assemblage, this portion amounts to 70.0%, in the Stene terrasse assemblage it amounts to 88.2%, in the Stokke/Polland assemblage it amounts to 74.1% and in the Vallermyrene assemblage 82.6% of the blades have non-remaining distal ends.

The remaining portion of the assemblages from Krøgenes and Stene terrasse consists of ideally terminated blades, like most of the remaining assemblages from the other sites. In the Stokke/Polland assemblage, there is a small portion of blades that has a feathered termination (6.9%). In the largest assemblage, Vallermyrene, we find a few blades that are feathered (1.1%), plunged (0.4%) or hinged (0.4%).

The complete blades from these sites show a lot of variation regarding the shape of their distal ends. The Krøgenes assemblage blades mostly have straight distal ends (10/13 blades), whereas the Vallermyrene blades have mainly pointed ends (30/46 blades). The remaining sites have equal numbers of blades in each category.

Blade curvature (CURV)

The variations of blade curvature in the focus areas have many similarities between the sites (Fig. 108). Straight or evenly curved blades are the two most common attribute morphologies in the focus area. In the Krøgenes assemblage, 40.6% of blades are straight and 37.5% are evenly curved. In the Stene terrasse assemblage, 5/10 blades are straight while 4/10 have an even curvature. The Stokke/Polland blades have slightly more blades with even curvature (46.5%) compared to straight blades (30.2%).

The Vallermyrene blades also have a near equal division, with 43.5% of blades with straight distal ends and 40.7% with pointed ends. Additionally, a remaining portion of the blades from Vallermyrene displays distal curvature (15.8%). Moreover, on the other sites there is a smaller portion of blades with distal curvature. On Krøgenes, this amounts to 21.9%, on Stene terrasse it is found on 1/10 blades and in the Stokke/Polland assemblage it amounts to 20.9%.

Blade twist (TWIST)

Most blades from the focus area lack blade twisting (around 60%, Fig. 109). In the Krøgenes assemblage, twisted blades amount to 37.8%, in the Stene terrasse material 3/10 blades are twisted, in the Stokke/Polland assemblage 44.7% of blades are twisted and from the Vallermyrene site 42.1% of blades are twisted.

Wallner lines (WN)

Most blades from the focus area either lack Wallner lines, or have fine lines that are situated mainly at the proximal part of the blade (Fig. 110). The assemblage from Krøgenes contains 52.5% of blades with fine proximal lines and 35% of blades without Wallner lines. In the Stene terrasse assemblage, almost all blades lack Wallner lines (15/16 blades). In the assemblage from Stokke/Polland, blades most commonly have fine Wallner lines (50.9%) or no Wallner lines (40.4%). The Vallermyrene site contains mainly blades without Wallner lines (44.2%).

There is also a presence of pronounced Wallner lines in most assemblages from the focus area, although limited in abundance. Among the Krøgenes blades, 12.5% have pronounced Wallner lines, in the Stokke/Polland they amount to 8.8% of the blades and from Vallermyrene 13% of blades have pronounced Wallner lines. No blades from Stene terrasse have this attribute morphology.

Blade regularity (REG)

The blades are commonly regular, followed by irregular blades (Fig. 111). Regular blades make up 72.5% of the blades on the Krøgenes site, 62.5% of those on Stene terrasse, 75% of those on Stokke/Polland and 75.2% of those on the Vallermyrene site. Irregular blades make up 5% of the Krøgenes assemblage, 31.3% of the Stene terrasse assemblage, 21.2% of the Stokke/Polland assemblage and 19.5% of blades in the Vallermyrene assemblage.

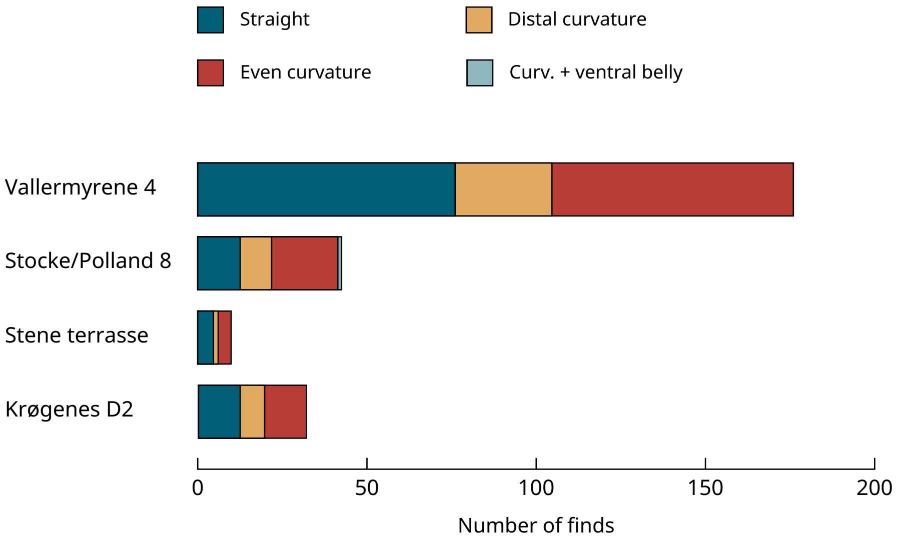


Figure 108. Blade curvature (CURV) on recorded blades from focus area 3, by site.

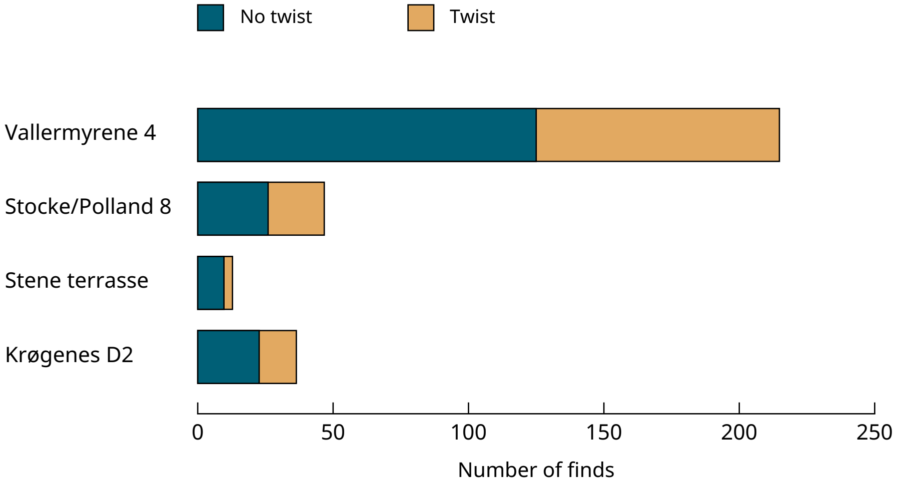


Figure 109. Blade twist (TWIST) on recorded blades from focus area 3, by site.

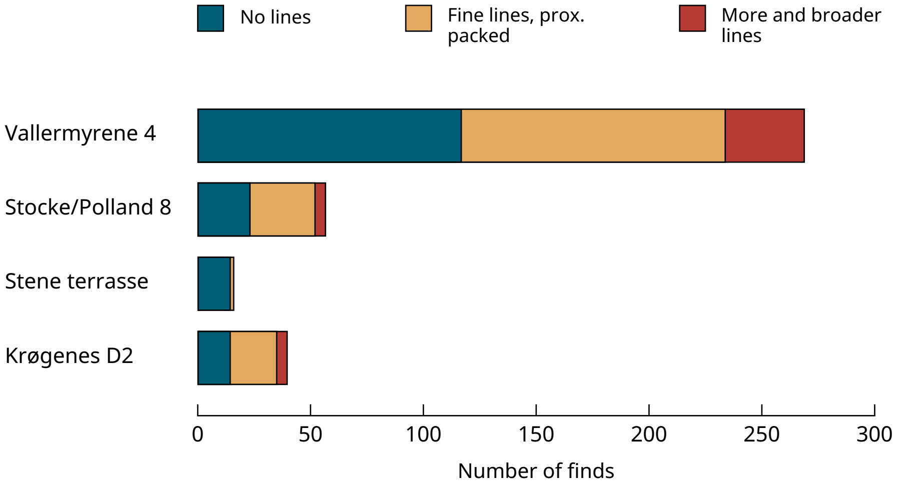


Figure 110. Wallner lines (WN) on recorded blades from focus area 3, by site.

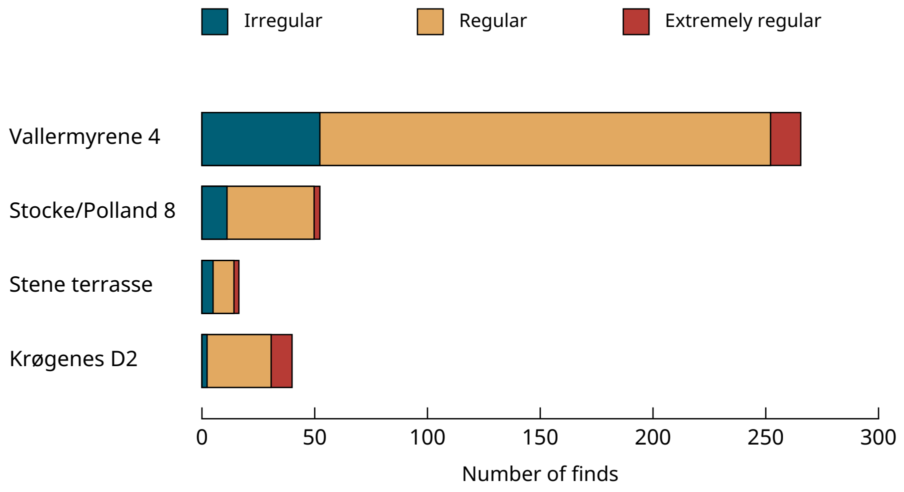


Figure 111. Blade regularity (REG) on recorded blades from focus area 3, by site.

The collection with the highest amount of extremely regular blades is the Krøgenes assemblage, which amounts to 22.5% of blades that are extremely regular. The remaining sites contain only 3-6% of extremely regular blades.

Platform preparation dorsal (SFPD)

Within the focus area, the most common manner of dorsal platform preparation is trimming (Fig. 112). On the Krøgenes site, trimming was used on 80% of the blades. This was followed by a combination of trimming and abrasion (10%), abrasion (7.5%) and a lack of preparation (2.5%). On Stene terrasse, the trimming was used on 10/16 blades. The remaining blades are equally divided between abrasion (2 blades), abrasion and trimming (2 blades) and no preparation (2 blades). Both sites have fewer blades that lack dorsal preparation than Stokke/Polland and Vallermyrene.

On Stokke/Polland, trimming appears on 65.5% of the blades, followed by no preparation (31%) and trimming and abrasion (3.4%). No blades from this site display abrasion. On the Vallermyrene site, trimming was used on 69.8% of the blades. The remaining assemblage is made up of blades without dorsal preparation (11.9%), trimming and abrasion (9.3%) or abrasion (9%).

Platform preservation (SFPE)

All assemblages from this focus area are dominated by blades with smooth platforms (Fig. 113). The two larger assemblages Stokke/Polland and Vallermyrene also contain a substantial percentage of blades with facetted platforms.

The Krøgenes assemblage consists of blades with smooth platforms (92.5%), while the remaining blades are faceted with two facets. A very similar pattern is seen in the assemblage from Stene terrasse, in which blades mainly have smooth platforms (14/15 blades). The remaining blade is faceted with two facets.

The blades from Stokke/Polland are mainly smooth (52.6%). The remaining blades mostly have faceted platforms with two (33.3%) or more facets (7%). Another portion of the blades has crushed platforms (7%).

The blades from Vallermyrene mainly have smooth platforms (67.3%) followed by blades that are faceted with two (21.5%) or multiple facets (5.8%). A small portion of the blades displays crushed platforms (3.8%).

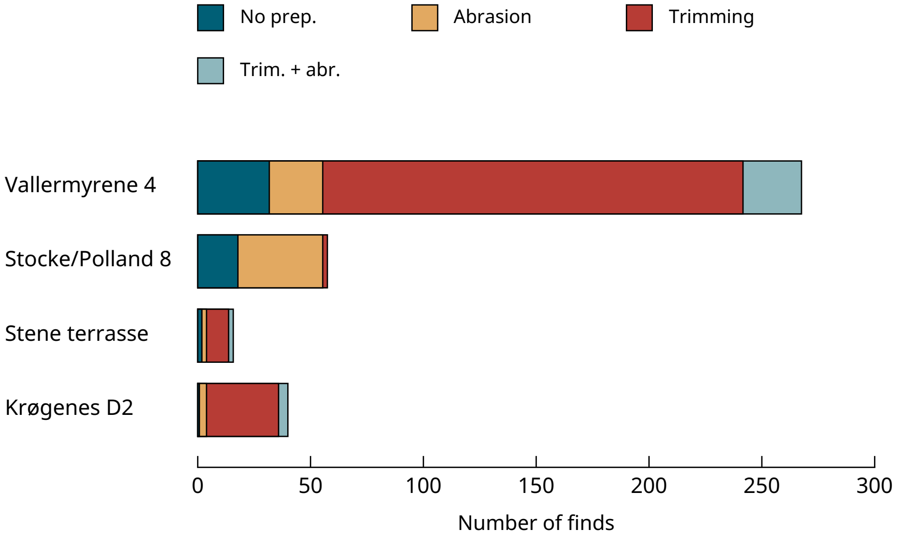


Figure 112. Platform preparation dorsal (SFPD) on recorded blades from focus area 3, by site.

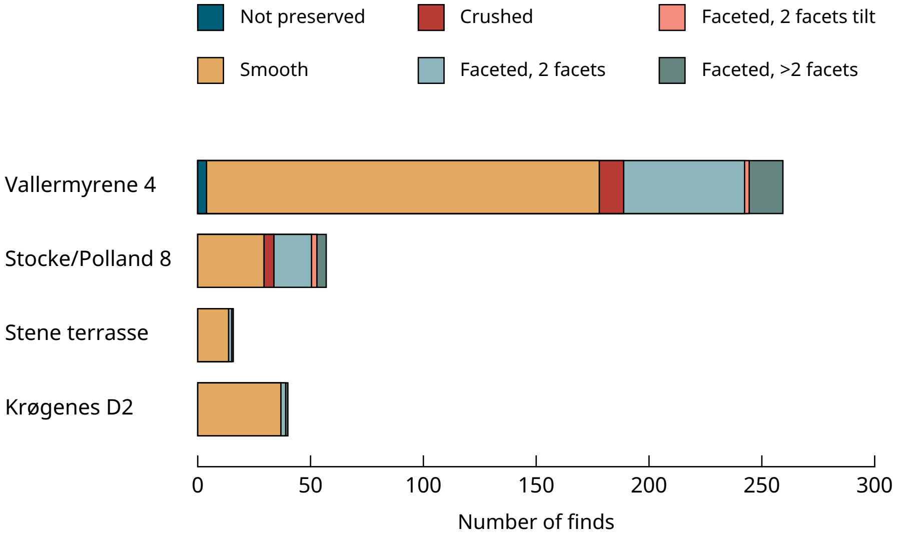


Figure 113. Platform preservation (SFPE) on recorded blades from focus area 3, by site.

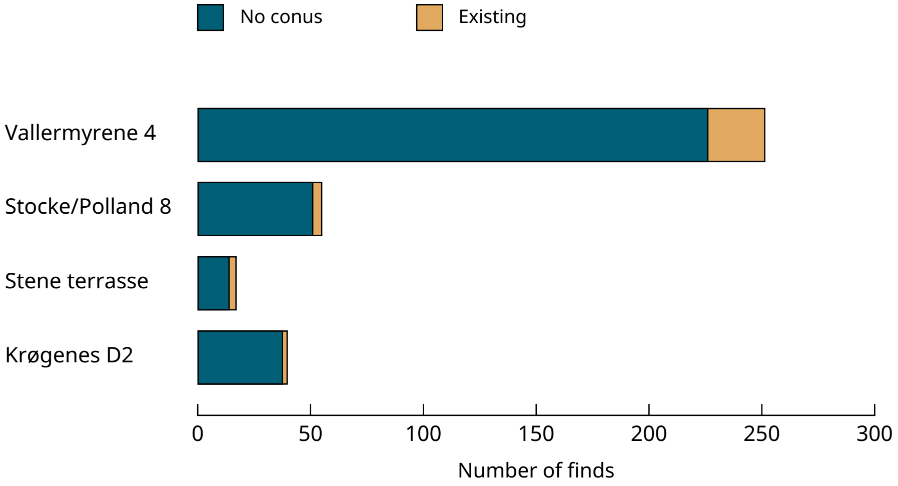


Figure 114. Conus formation (KE) on recorded blades from focus area 3, by site.

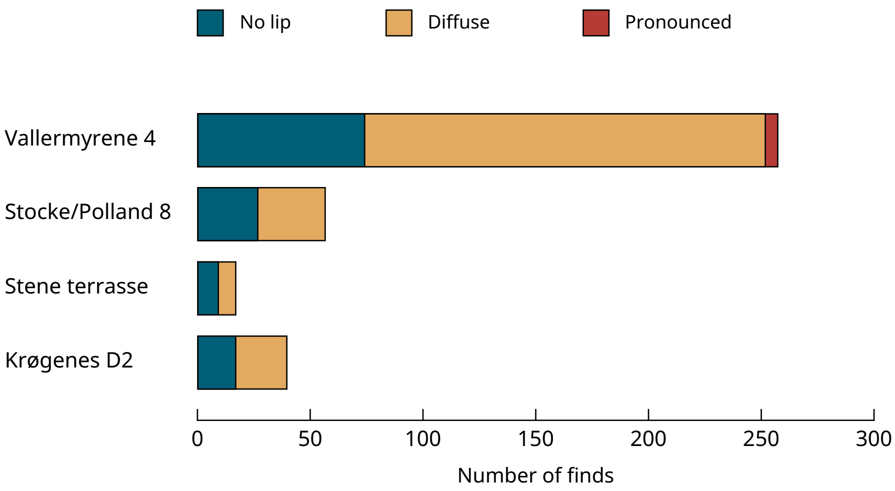


Figure 115. Lip (SL) on recorded blades from focus area 3, by site.

Conus formation (KE)

Conus formation is very uncommon within the focus area (Fig. 114). Each site contains a large majority of blades without any form of conus formation. In the Krøgenes assemblage, 95% lacks conus formation, in the Stene terrasse assemblage 82.4%, in the assemblage from Stokke/Polland 92.7% and on the Vallermyrene site 90% of the blades.

Lip (SL)

Most blades have either a diffuse lip or no lip. Only a handful of blades from Vallermyrene display pronounced lips (Fig. 115).

On the Krøgenes site, blades are almost equally divided between having no lip (42.5%) and a diffuse lip (57.5%). In the same way, the blades from Stene terrasse are almost equally distributed between the two categories, with blades without a lip being represented by 52.9% and diffuse lips by 47.1% of the assemblage.

The same relationship is also seen in the assemblage from Stokke/Polland, in which 52.6% of the blades have diffuse lips and 47.4% have no lip. In the assemblage from Vallermyrene, a slightly different pattern becomes visible as most blades have diffuse lips (69.3%) followed by blades without lips (28.8%). As mentioned, a small portion of the blades also has pronounced lips (1.9%).

Platform width (SFRD) and platform thickness (SFRK)

The datasets from the different sites show that the widest platforms are found in the assemblage from Vallermyrene, followed by Krøgenes, Stokke/Polland and lastly Stene terrasse (Table 45). Interestingly, the platform thickness does not follow the same order. Instead, the thinnest platforms are found in the two assemblages with the widest platforms (Krøgenes and Vallermyrene). These two sites thus have platforms that are wide but thin.

The platform sizes for Stene terrasse show a ratio close to 2:1 for platform width to thickness. The blades from Stokke/Polland have platforms that are small in width but large in thickness.

Krøgenes, Stokke/Polland and Vallermyrene all have a similar standard deviation value, for platform width, at around 0.8 mm. Stene terrasse has a less varied assemblage. For platform thickness, the standard deviation shows the same amount of variation at around 0.3 mm in all assemblages.

Focus area 3 – Krøgenes D2

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Butt width (SFRD)	1.1	1.975	2.5	2.655	3.225	4.2	0.85153	40
Butt thickness (SFRK)	0.5	0.8	0.9	1.038	1.225	1.9	0.377364	40

Focus area 3 – Stene terrasse

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Butt width (SFRD)	1.6	1.9	2.3	2.288	2.5	3.1	0.444244	17
Butt thickness (SFRK)	0.7	0.8	1	1.065	1.2	1.8	0.314128	17

Focus area 3 – Stokke/Polland 8

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Butt width (SFRD)	1.3	1.975	2.45	2.58	3.125	4.2	0.789803	56
Butt thickness (SFRK)	0.4	0.9	1.1	1.086	1.3	2.1	0.314168	56

Focus area 3 – Vallermyrene 4

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Butt width (SFRD)	0.9	2.2	2.6	2.739	3.1	5.5	0.870562	258
Butt thickness (SFRK)	0.4	0.8	1	1.045	1.2	2.5	0.345834	258

Table 45. Platform width (SFRD) and platform thickness (SFRK) in focus area 3, by site.

Blade sizes – Length (L), width (B) and thickness (D)

A comparison between the assemblages within the focus area shows that blade sizes are rather homogenous (Table 46; Fig. 116). Blade lengths vary between 11.30 to 31.8 mm (min and max value) with means between 19.32 mm and 21.9 mm. Blade widths vary between 3.5 and 10.9 mm, with means between 5.7 and 6.4 mm. The thickness of blades varies between 0.6 to 6.6 mm, with means between 1.4 and 1.6 mm.

The assemblage from Krøgenes has shorter (L) and thinner (D) blades, according to the mean values, while the blades from Stene terrasse provide the highest mean length and largest mean thickness. This assemblage also contains the blades with the smallest mean width compared to the other sites. Stene terrasse thus has the longest and thickest blades, but also the narrowest. The highest mean width comes from Vallermyrene.

The most homogenous blade lengths (as indicated by low SD-values) are found in the dataset from Krøgenes. The most variety (high SD-values) is instead found at Stene terrasse. Similarly, the most homogenous dataset, relating to blade thickness, comes from Krøgenes and the most varied is that from Stene terrasse. For blade width, the situation is the opposite, with the most homogenous dataset from Stene terrasse and the most varied dataset from Krøgenes.

Focus area 3 – Krøgenes D2

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Blade length (L)	14.3	19	19.5	*19.32*	19.8	25.5	2.626419	13
Blade width (B)	3.5	5.075	6.15	6.205	7.3	8.3	1.305796	40
Blade thickness (D)	0.7	1.2	1.4	*1.445*	1.7	2.2	0.335085	40

Focus area 3 – Stene terrasse

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Blade length (L)	16.8	19.35	21.9	**21.9**	24.45	27	7.212489	2
Blade width (B)	4.5	5	5.5	*5.629*	6.2	7.1	0.796684	17
Blade thickness (D)	1	1.2	1.4	**1.624**	1.5	5.1	0.971809	17

Focus area 3 – Stokke-Polland 8

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Blade length (L)	14.9	17.6	20.1	20.31	23.15	25.1	3.339844	14
Blade width (B)	3.5	4.85	5.9	5.812	6.625	8.2	1.104866	58
Blade thickness (D)	0.8	1.1	1.4	1.503	1.8	2.6	0.455364	58

Focus area 3 – Vallermyrene 4

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	SD	n
Blade length (L)	11.3	16.15	19	19.74	22.48	31.8	5.032184	46
Blade width (B)	3.7	5.5	6.2	**6.377**	7.1	10.9	1.294702	270
Blade thickness (D)	0.6	1.1	1.4	1.45	1.6	6.6	0.619614	270

Table 46. Blade sizes in focus area 3. The largest mean values are marked in bold and the smallest values are marked in italic.

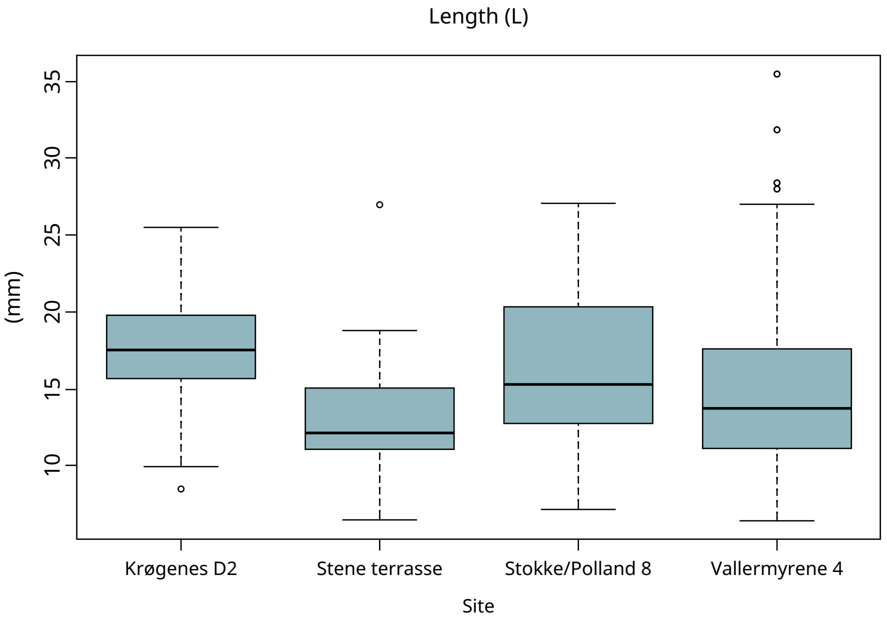
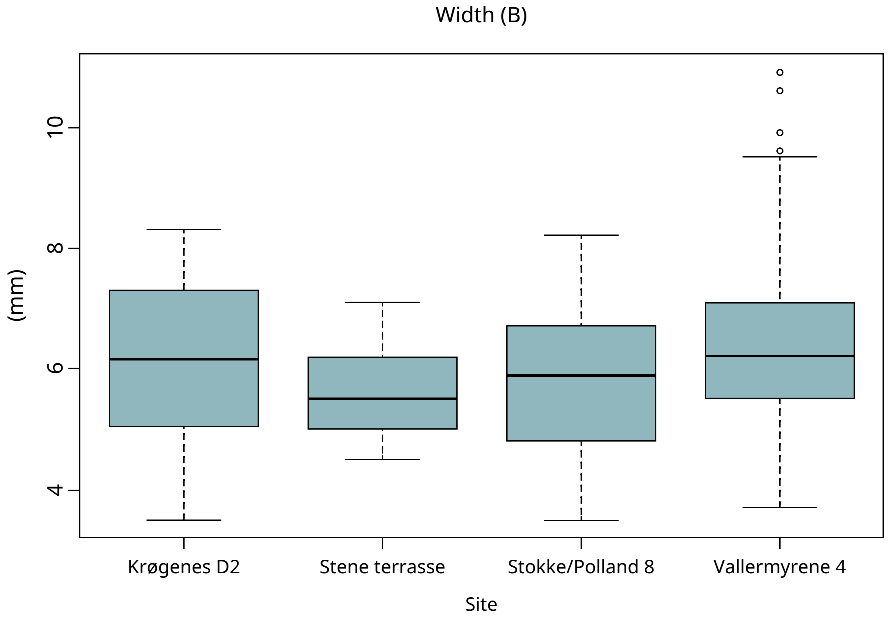
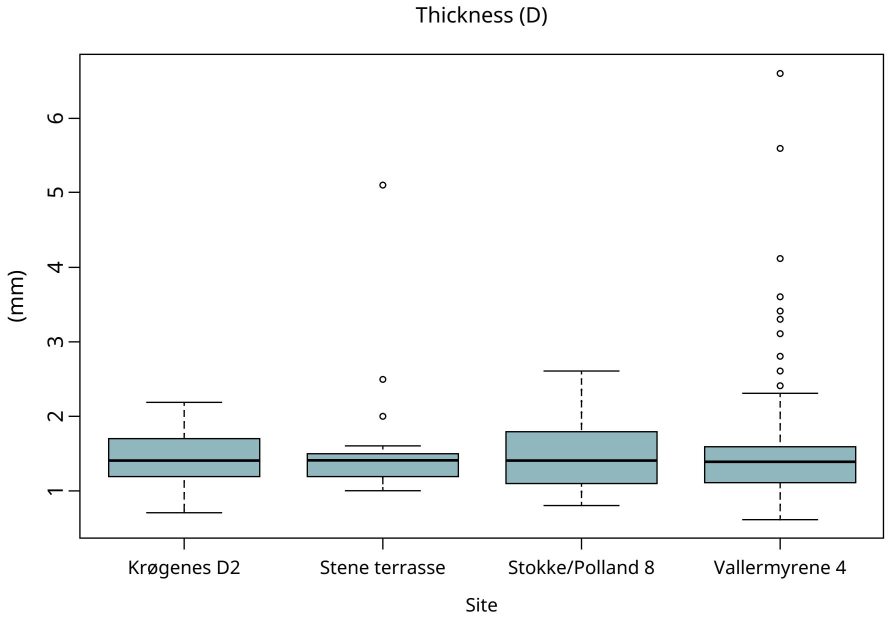


Figure 116 (continued on following page). Boxplots of blade length (L), width (B) and thickness (D) measured in millimetres within focus area 3, by site. Mean values and interquartile ranges are shown in Table 46.

Summary focus area 3

The cores from focus area 3 commonly have a single platform, a single core front and are mostly made from nodules. The core rejuvenation strategy varies across the focus area. In the assemblages from the bigger sites in the focus area, there are many cores with smooth platforms, although faceting or partial faceting is not uncommon. Some of the smaller assemblages indicate equal proportions of faceted/smooth platforms. The backs of the cores are most often shaped by striking away multiple flakes, or left unworked. Core sides commonly show multiple flake negatives, followed by flake negatives in combination with side platform preparation or cortex. Dorsal preparation often appears in the form of trimming. The angle between the front and the platform is varied across the focus area. Cores sizes are similar across the area, with a mean core height of 22-26 mm and mean width of 18.5-23 mm.





Blades from F3 were mainly produced during the main blade production phase, as indicated by the systematic dorsal preparation. Further arguments are provided by the distal blade ends which are categorised as terminated, followed by ideally terminated. Straight blades are most common in the assemblages from Krøgenes D2, Stene terrasse and Vallermyrene 4, while evenly curved blades are more common in the assemblages from Stokke/Polland 8. Most blades lack any blade twisting. Most assemblages have many blades with fine Wallner lines, followed by no Wallner lines. Only on Stene terrasse are most blades without Wallner lines. On the Vallermyrene site, the percentage with fine Wallner lines is only slightly higher than no lines. Most blades from each site are regular, followed by irregular. Platform preparation was mainly conducted by means of trimming. The assemblages from Krøgenes D2 and Stene terrasse are mainly made up of blades with smooth platforms. The majority of blades is also smooth from Stokke/Polland 8 and Vallermyrene, however, a considerable number of blades also has faceting (27.3-40.3%). Most blades lack any form of conus formation. A majority of the blades in the assemblages Krøgenes D2, Stokke/Polland 8 and Vallermyrene has diffuse lips followed by no lip. The opposite pattern is found among the blades from Stene terrasse, which contains mainly blades without lips followed by diffuse lips. Blade butt sizes are rather homogenous on the different sites in the focus area. The same pattern is also seen in the blade sizes in general.

6.1.1.5 Focus area 4 – Southern Lithuania

The blades from the Lithuanian assemblages were not recorded (see 4.1). The technological comparisons for this area are thus limited to the data collected from the cores (cf. Chapter 5.1.1.5).

Platform design (KSFA) and platform use (KSFN)

Most cores in the assemblage from F4 have a single platform (91.5%). Some cores have a second platform, placed either on the opposite side of the core (2.1%) or otherwise arranged (6.4%). The secondary platforms were used subsequent to the first one (Fig. 117).

Core front design (KAAN)

Most of the cores from F4 have one single core front (93.6%), while the remaining ones have a second front, placed independently from the first (Fig. 118).

Handle core on flake (HCF)

Most cores were made from a nodule (95.7%) rather than a flake (4.3%) (Fig. 119).

Core back (KR)

The backs of the cores are almost equally divided between being unprepared (53.5%) and having flake negatives (46.5%) (Fig. 120).

Core side 1 (KS1) and core side 2 (KS2)

Core side 1 and 2 most commonly show flake negatives (55.6 and 51.1% respectively), followed by a lack of preparation (20% on each side) and the presence of one flake negative (11.1% and 17.8% respectively). Any presence of lateral

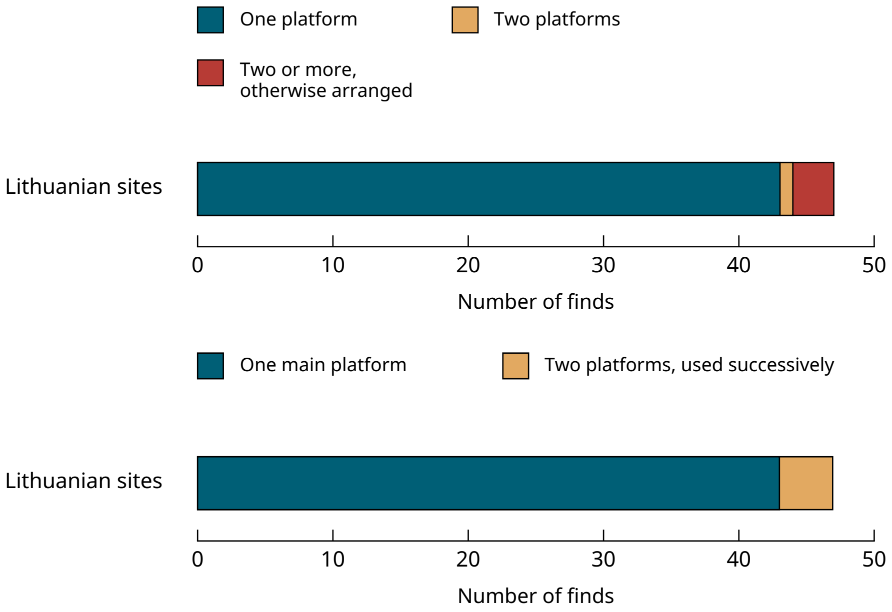


Figure 117. Platform design (KSFA, first bar graph) and platform use (KFSN, second bar graph) on recorded cores from focus area 4.

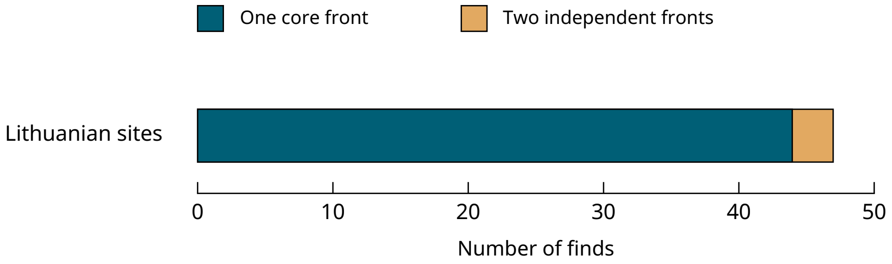


Figure 118. Core front design (KAAN) on recorded cores from focus area 4.

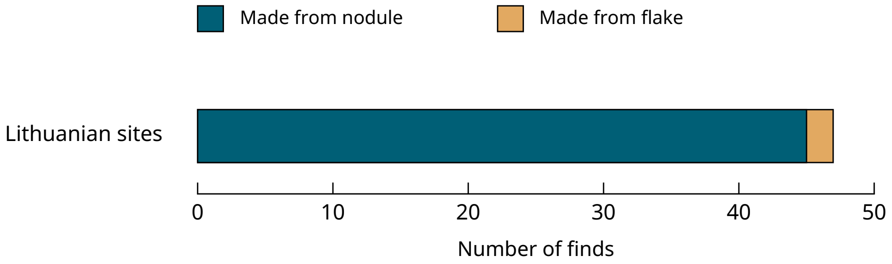


Figure 119. Handle core on flake (HCF) of recorded cores from focus area 4.

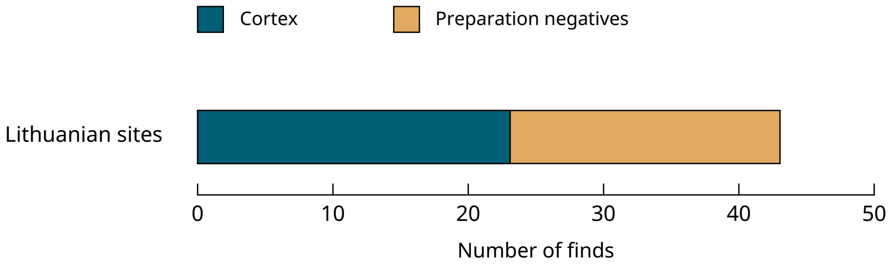


Figure 120. Core back (KR) on recorded cores from focus area 4.

F4 – Various sites in Southern Lithuania							
	Cortex (1)	Flake negatives (3)	One flake negative (4)	Cortex + lat edge prep (6)	Flake negatives + lat edge prep (7)	One flake negative + lat edge prep (8)	Number of finds total
F4 KS1	9 (20%)	25 (55.6%)	5 (11.1%)	1 (2.2%)	4 (8.9%)	1 (2.2%)	45 (100%)
F4 KS2	9 (20%)	23 (51.1%)	8 (17.8%)	0 (0%)	3 (6.7%)	2 (4.4%)	45 (100%)

Table 47. Core side preparation in focus area 4.

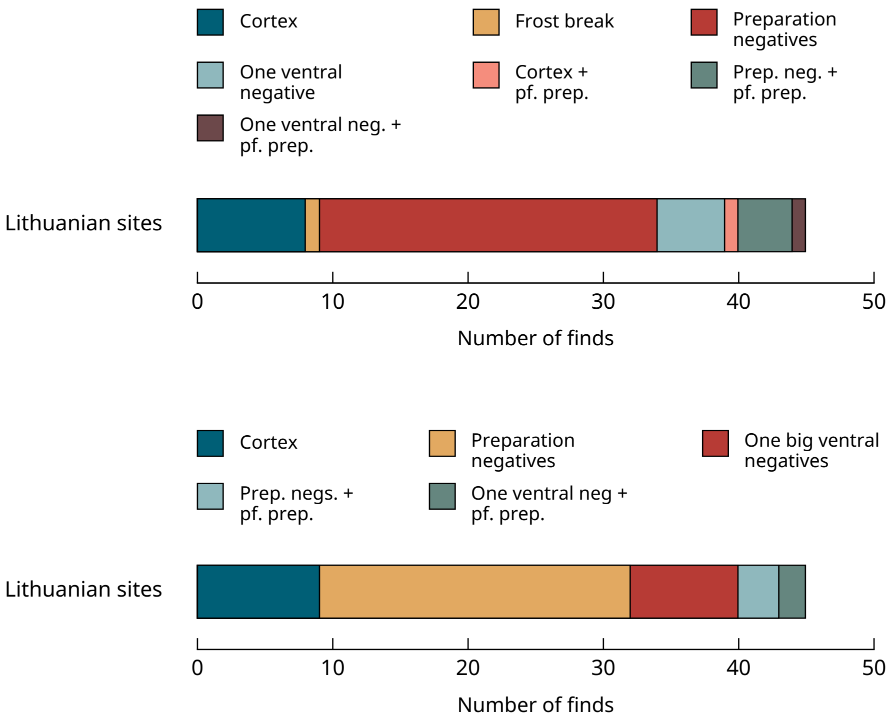


Figure 121. Core side 1 (KS1, first bar graph) and core side 2 (KS2, second bar graph) on recorded cores from focus area 4.

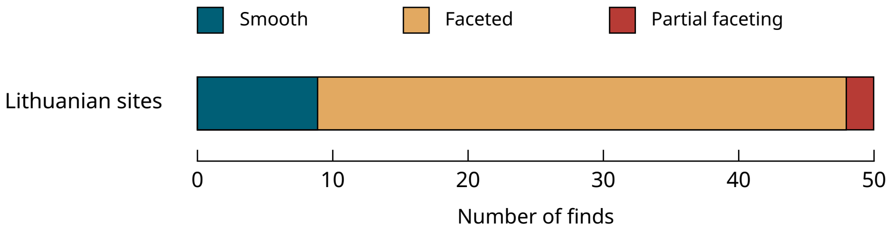


Figure 122. Platform morphology (PMORPH) on recorded core fronts from focus area 4. Note that some cores have two core fronts which result in a higher number of observations than individual cores.

edge preparation exists in low amounts. For core side 1, 13.3% have traces of a combination that includes lateral edge preparation, while 11.1% of cores have lateral edge preparation on KS2 (Table 47; Fig. 121).

Platform morphology (PMORPH)

Most cores from this assemblage have faceted platforms (78%). Smooth platforms are also present (18%) followed by partial faceting (4%) (Fig. 122).

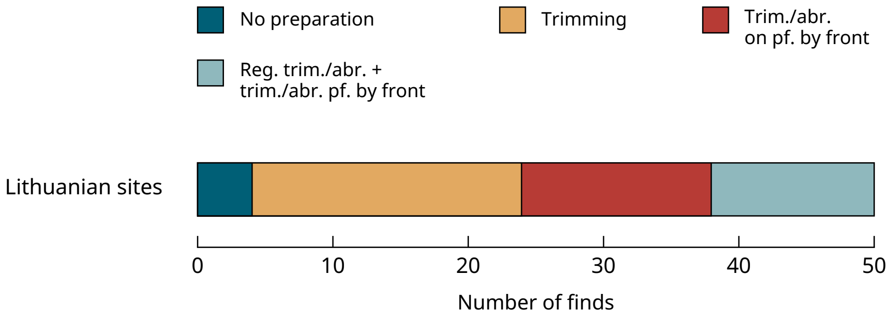


Figure 123. Platform preparation core dorsal (PPCD) on recorded cores from focus area 4. Note that some cores have two core fronts, resulting in a higher number of observations than individual cores.

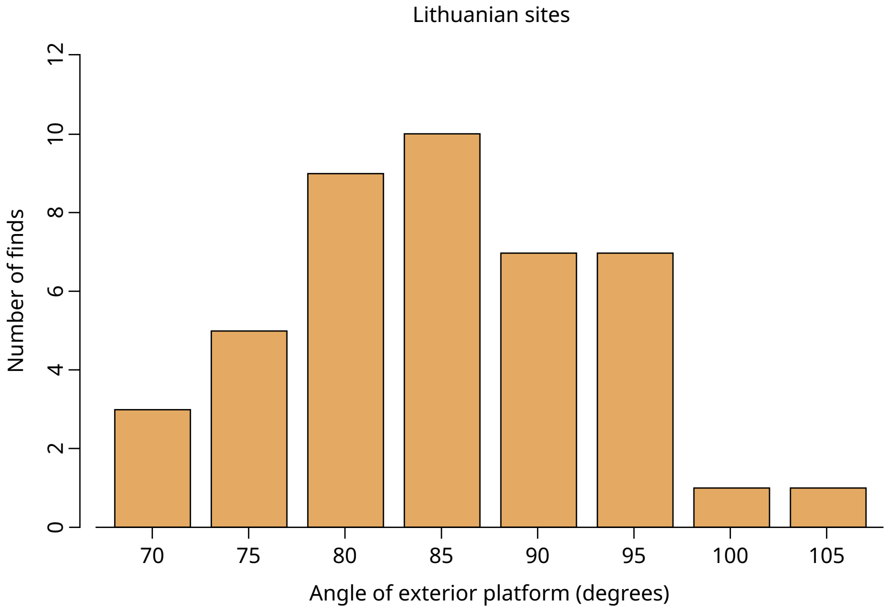


Figure 124. Exterior platform angle (EPANG) on recorded cores from focus area 4. Note that some cores have two core fronts, resulting in a higher number of observations than individual cores.

Platform preparation core dorsal (PPCD)

The remains of dorsal preparation among the cores from F4 are varied and include trimming (40.8%), trimming and/or abrasion on top of the platform (28.6%) and a combination of regular trimming and trimming/abrasion on top of the platform (22.4%). A smaller percentage of cores lack dorsal preparation (8.2%) (Fig. 123).

Exterior platform angle (EPANG)

The exterior platform angles on the cores vary from 70 degrees to 105 degrees. Most of the cores fall into the categories 80 and 85 degrees (together amounting to 44.5%), followed by categories 90 and 95 degrees (32.6%), 75 degrees (11.6%) and lastly 100 and 105 degrees (2.3% each) (Fig. 124).

Core sizes – Length (L), width (B) and thickness (D)

The average height, width and length of cores are 44.83 mm, 27.84 mm and 43.7 mm, respectively. The standard deviations indicate that there is some variety among the measurements relating to core height (L) and length (D) (Table 48).

F4 – Various sites in Southern Lithuania								
	Min.	**1st Qu.**	**Median**	**Mean**	**3rd Qu.**	**Max.**	**SD**	**n**
Core height (L)	24.60	37.70	42.60	44.83	51.50	69.50	9.766969	47
Core width (B)	17.50	24.65	28.00	27.84	31.45	36.90	5.038363	47
Core length (D)	26.90	36.20	42.70	43.70	49.80	66.40	10.15523	45

Table 48. Cores sizes (height, width and length) in focus area 4.

Attribute	Total no. of finds	No. of finds	Attribute morphology
Platform design (KSFA)	5	5	one platform
		0	2, opposing
		0	2 or more, otherwise arranged
Platform use (KSFN)	5	5	one main platform
		0	2 equivalent PF, successively
Core front design (KAAN)	5	2	one core front
		0	2 independent
		3	2 opposing
Handle core on flake (HCF)	5	2	not made on flake
		3	made on flake
Core back (KR)	5	3	not available
		1	cortex
		1	preparation negative
		0	one big negative (ventral/dorsal)
Core side 1 (KS1)	5	0	cortex
		2	preparation negatives
		0	one big negative (ventral/dorsal)
		1	cortex + platform prep
		1	preparation negs + plat prep
		1	one negative + platform prep

Table 49 (continued on following page). Recorded core attributes from the site Grądy-Woniecko, Northern Poland.

Attribute	Total no. of finds	No. of finds	Attribute morphology
Core side 2 (KS2)	5	0	cortex
		1	preparation negatives
		1	one big negative (ventral/dorsal)
		0	cortex + platform prep
		1	preparation negs + plat prep
		2	one negative + platform prep
Exterior platform angle (EPANG)	8	0	50 degrees
		2	55 degrees
		0	60 degrees
		1	65 degrees
		1	70 degrees
		3	75 degrees
		0	80 degrees
		1	85 degrees
		0	90 degrees
		0	95 degrees
		0	100 degrees
		0	105 degrees
		0	110 degrees
		0	115 degrees
Platform morphology (PMORPH)	5	4	smooth/plain
		0	faceted platform
		1	partial faceting
Platform width (KSFB) and Platform thickness (KSFD)	5	27.7	mean width
		65	mean thickness
Platform preparation core dorsal (PPCD)	8	1	no preparation
		1	abrasion
		3	trimming
		3	trimming and abrasion
		0	trimming/abrasion ON platform
		0	regular trimming/abrasion + trim/abr ON platform

Summary for focus area 4

The cores from focus area 4 commonly have a single platform, a single core front and are most often made from nodules. Most of the cores have faceted platforms, although smooth ones also exist. These differences could relate to regional or chronological variance, but the few cores from each site and a lack of dated sites do not allow for the identification of reliable patterns. The cores commonly have unprepared backs or backs with preparation negatives. Core sides commonly show multiple flake negatives, followed by a lack of preparation or one large platform negative. Lateral edge preparation exists in only a few cases (11-13%). Dorsal preparation appears either as "regular" trimming/abrasion (ca. 41%) or as some variation that includes trimming/abrasion on top of the core platform (51%). The angle between the core front and the platform mainly varies between ca. 80 or 85, followed by 90 and 95 degrees. The mean core height is ca. 45 mm, the mean core width is ca. 28 mm and the mean core length is ca. 44 mm. Blades were not recorded from this focus area, thus little can be said about the methods and techniques involved in the blade production.

6.1.1.6 Outside the focus areas – Poland

Five flint cores/preforms from a nodule deposit at the site Grądy-Woniecko were recorded within the scope of this project. These cores are presented in absolute numbers due to the small sample size (Table 49, 190-191).

6.1.2 Supra-regional comparisons between focus areas

To compare the assemblages regionally, the data from the focus areas is combined and presented.

6.1.2.1 Comparing cores

Platform design (KSFA) and platform use (KSFN)

The manner of creating and using platforms is very similar in all focus areas (Fig. 125). In each focus area, more than 90% of the cores were designed to have one single platform. Cores with one single platform are especially common in F2a, F2b and F3, where single platforms are found on 97.5-100% of the cores.

The cores that do have a second platform either have them placed on the opposite side of the core, which is most common in Focus area 1, or have them arranged otherwise, which is found in areas F2a, F2b and F3. The cores from F4 have both varieties. For each focus area, the secondary platform was used subsequent to the first one. Thus, the initial platform was discarded before the second one was implemented.

Core front design (KAAN)

The core front is designed in a similar manner in the different focus areas. Each focus area has a majority of cores with one single core front. F1 has the highest number of secondary core fronts, amounting to 14.8% of the assemblage. In other focus areas, secondary fronts are only present only on 9.2% (in F2a), 3.7% (in F2b), 3.3% (in F3) and 6.4% (in F4) of the assemblages.

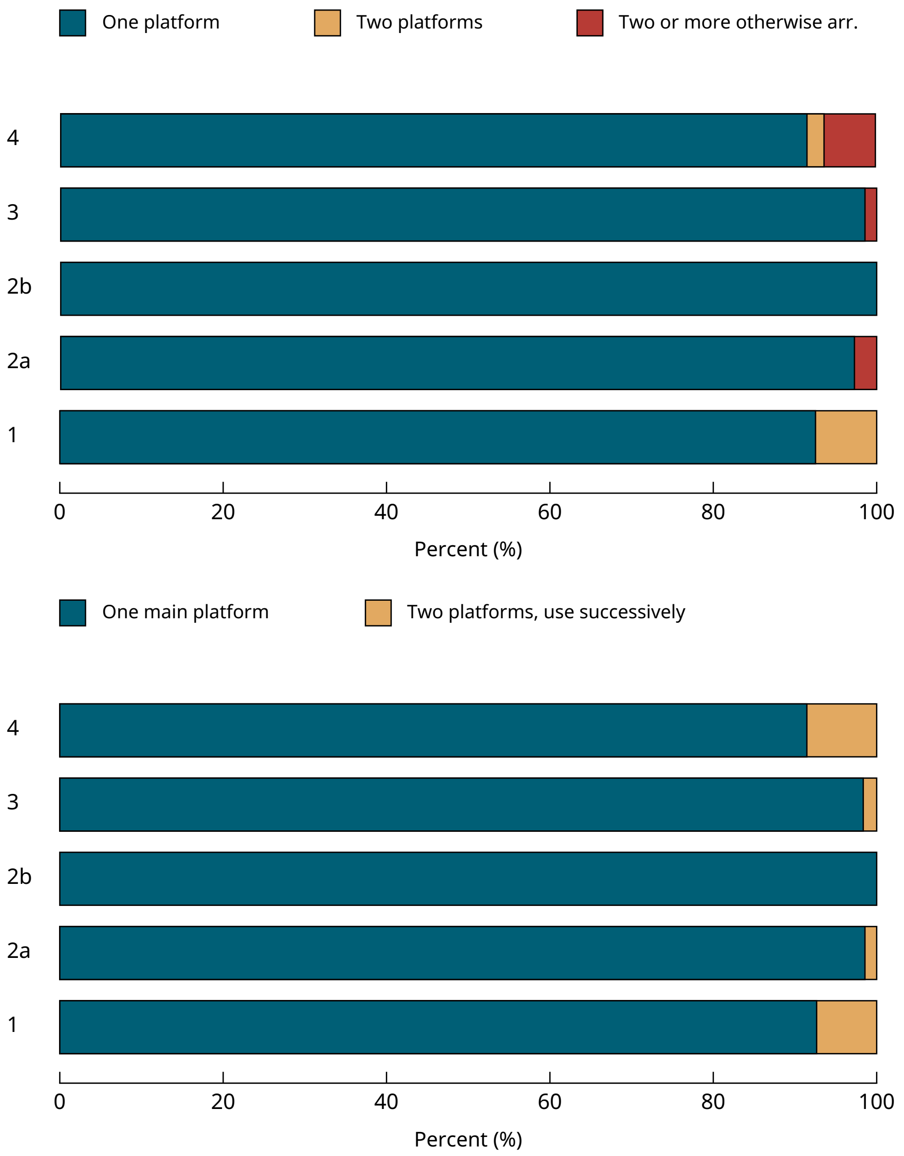


Figure 125. Platform design (KSFA, first bar graph) and platform use (KSFN, second bar graph) on recorded cores from all focus areas.

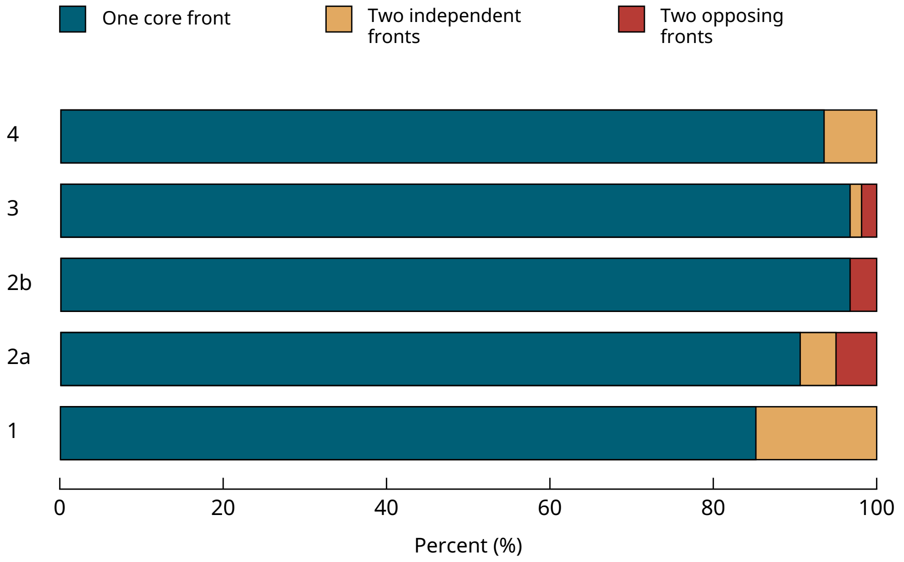


Figure 126. Core front design (KAAN) on recorded cores from all focus areas.

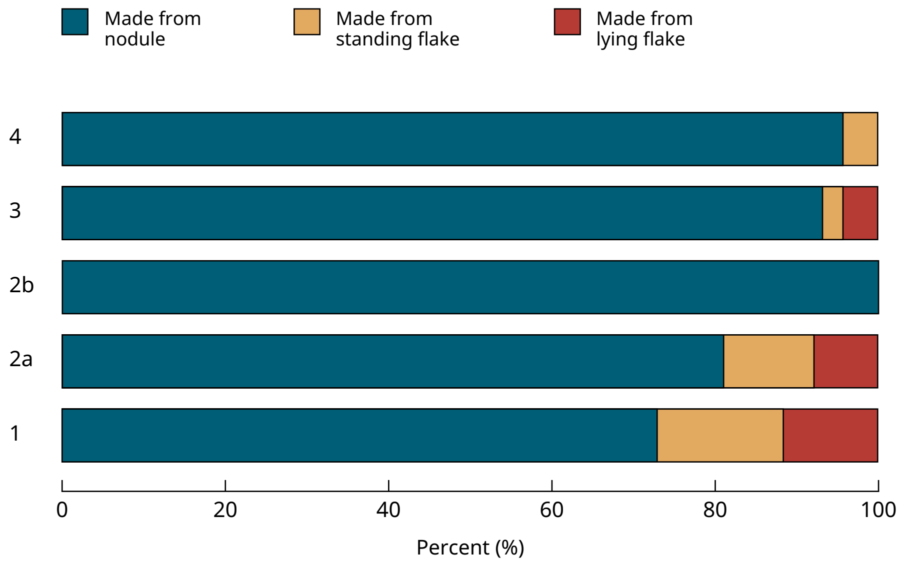


Figure 127. Handle core on flake (HCF) of recorded cores from all focus areas.

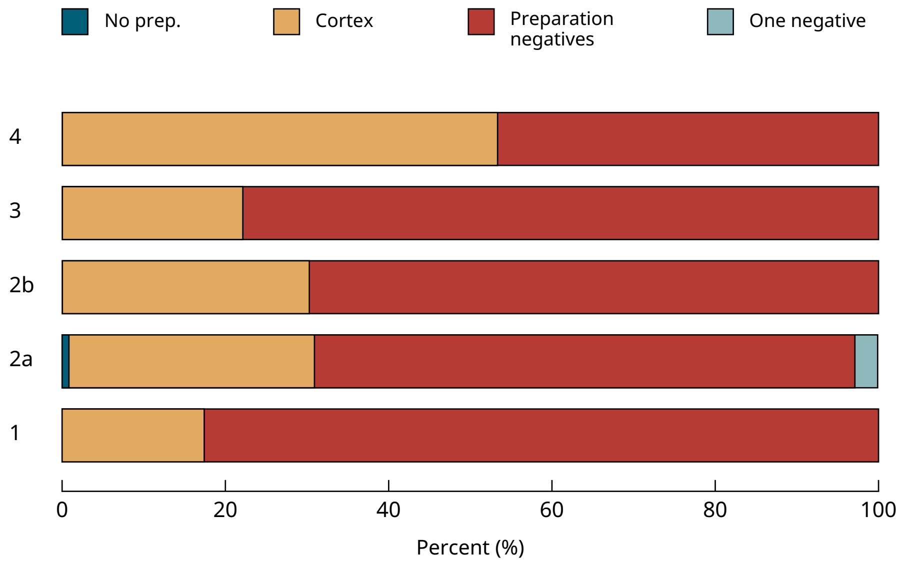


Figure 128. Core back (KR) on recorded cores from all focus areas.

The exact placement of the secondary front seems to vary between the different focus areas. In F1, F2a and F2b, secondary core fronts are most often placed on the opposite side of the platform. For the cores from F3, opposite and independent placement are equally common. In the assemblage from F4, the secondary core fronts are often placed independent of the first front (Fig. 126).

Handle core on flake (HCF)

The starting point of the core was commonly a nodule rather than a flake. In F2b, 100% of the cores were made from nodules. In areas F3 and F4, more than 90% of cores were made from nodules. In F2a, 81% of the cores were made from nodules. In F1, 73.1% of the cores were made from nodules (Fig. 127).

Core back (KR)

The preparation and shaping of the core back are often done through the removal of flakes. In the areas F1, F2a, F2b and F3, most of the cores (>50%) were prepared

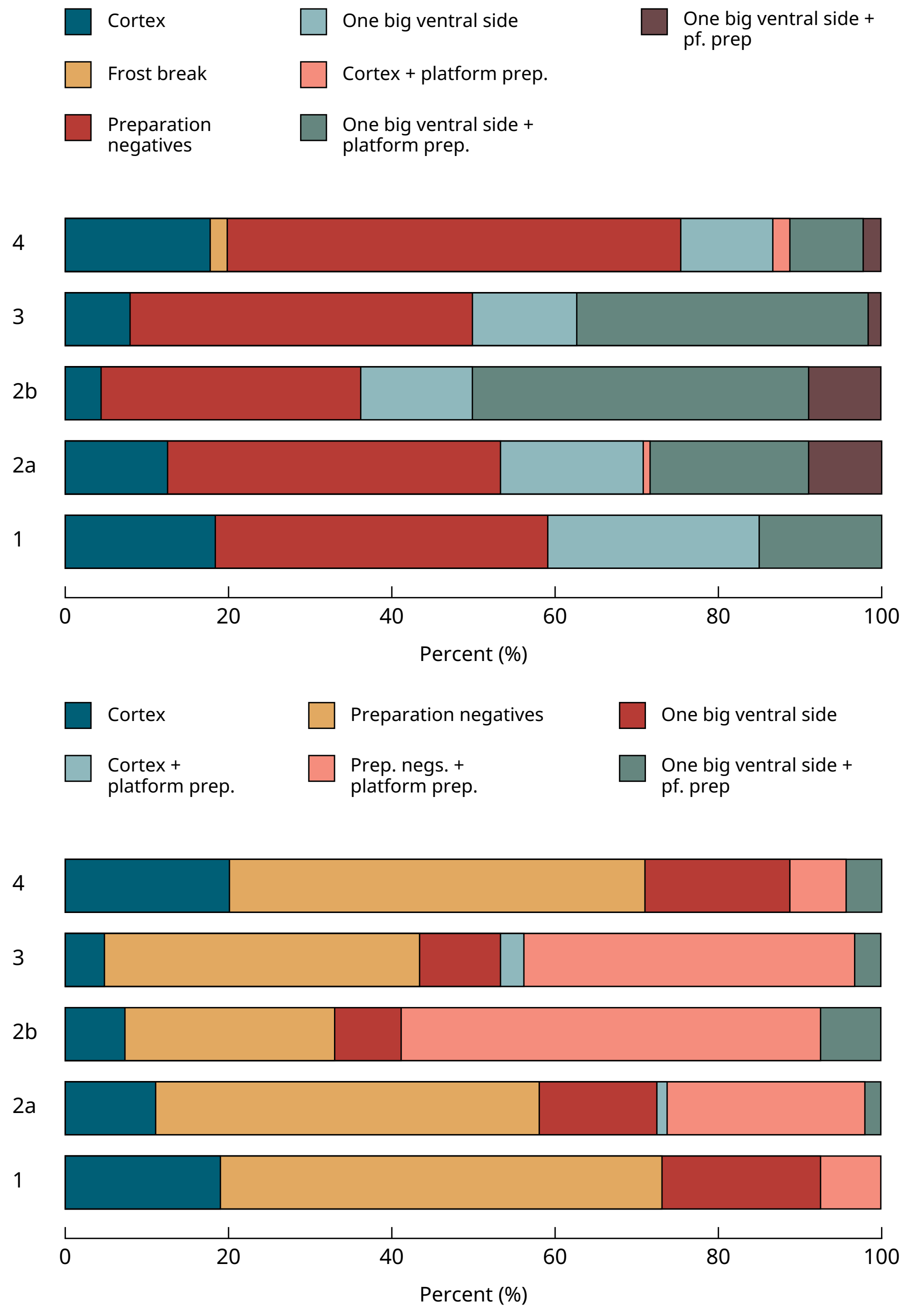


Figure 129. Core side 1 (KS1, first bar graph) and core side 2 (KS2, second bar graph) on recorded cores from all focus areas.

in this manner. It is also common to leave the back of the core unprepared, with a remaining cortex, as is most common among the cores from F4 (Fig. 128).

Core side 1 (KS1) and core side 2 (KS2)

There are some similarities between the different focus areas regarding the core sides. A general trend is that most core sides are prepared through the removal of flakes, as seen by the remains of multiple flake negatives. This is often found in combination with lateral edge preparation. These two traits, together, were used for the preparation of the core sides on a majority (>50%) of the cores in each focus area.

A difference can be seen in the amount of cortex on the sides of the cores. There are higher amounts of cores with remaining cortex in areas F1 (KS1: 18.5%

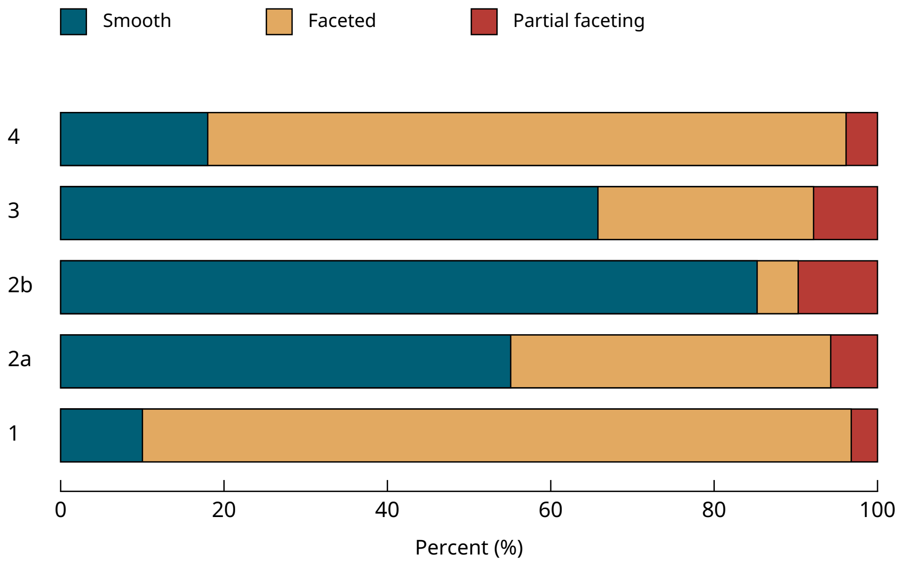


Figure 130. Platform morphology (PMORPH) on recorded cores from all focus areas.

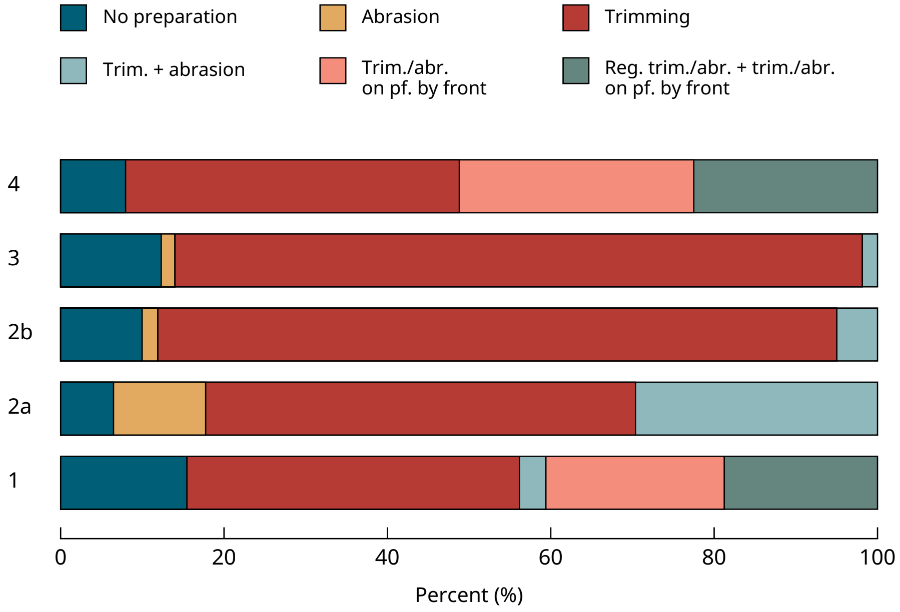


Figure 131. Platform preparation core dorsal (PPCD) on recorded cores from all focus areas.

and KS2: 19.2%) and F4 (17.8% and 20%) compared to areas F2a (12.6% and 11.1%), F2b (4.5% and 7.4%) and F3 (8.1% and 4.5%).

Another difference between the areas regards the amount of lateral edge preparation. The cores from F2b have higher amounts of lateral edge preparation (50% and 59.3%), followed by F3 (37.1% and 46.7%) and F2a (29.2% and 27.5%). Lateral edge preparation is found in smaller amounts among the cores from F1 (7.7% and 14.8%) and F4 (13.3% and 11.1%) (Fig. 129).

Platform morphology (PMORPH)

Platform morphology also varies between the different areas. Most cores in F2a (55%), F2b (85%) and F3 (65.8%) have smooth platforms, while most cores in F1 (89.7%) and F4 (82%) have faceted/partially faceted platforms (Fig. 130).

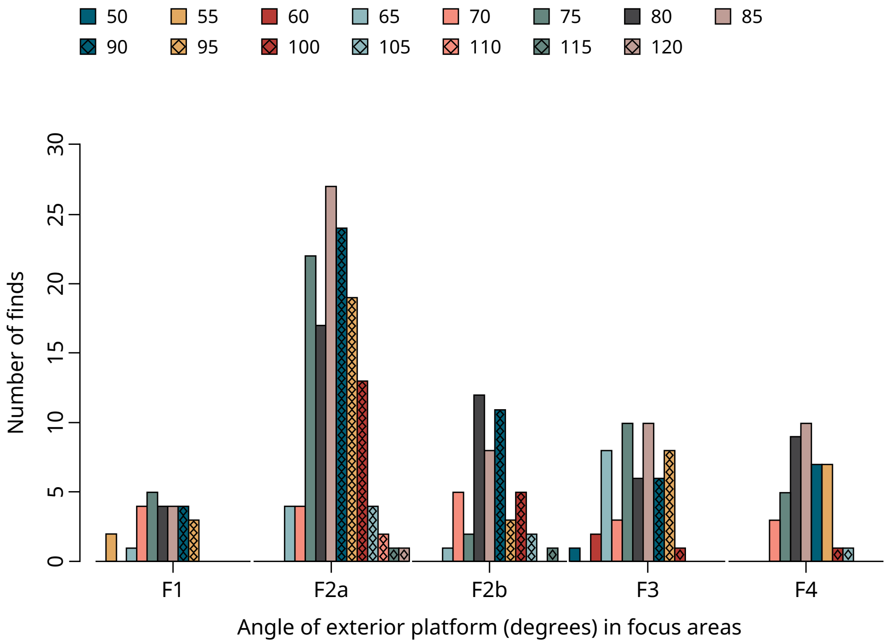


Figure 132. Exterior platform angle (EPANG) on recorded cores from all focus areas.

Platform preparation core dorsal (PPCD)

The dorsal platform preparation across the research area shares some similarities, although some differences can be observed. Trimming was used similarly, which is also the most common trait in each focus area. In F1 and F4, trimming amounts to 40.6% and 40.8%, respectively. It is also common for cores from the two sites to have trimming and abrasion on the platform (21.9-28.6%) and a combination of regular trimming and trimming or abrasion on the platform (18.8-22.4%). This combination located on top of the platform was not found in F2a, F2b or F3.

In F2a, trimming exists on 52.7% of the cores, followed by trimming and abrasion (29.3%) and abrasion (11.3%). Remaining cores lack dorsal preparation. In F2b, trimming is very common and found on 83.1% of the cores. The remaining cores either lack dorsal preparation (10.2%), have a combination of trimming and abrasion (5.1%) or show only abrasion (1.7%). A high amount of the cores from F3 also has trimming (84.4%), followed by a lack of preparation (12.5%), equal proportions of abrasion (1.6%) and trimming and abrasion (1.6%) (Fig. 131).

Exterior platform angle (EPANG)

The exterior platform angles vary both within each focus area but also between them. The core angles of cores from focus area 1 are almost equally distributed between 75 and 90 degrees. In focus area 2a, the measured core angles fall into a normal distribution pattern with a peak between 85 and 90 degrees. The cores from focus area 2b are almost equally distributed between 80 and 100 degrees. The cores from focus area 3 are well spread between 65 and 95 degrees without any more precise patterns. The cores from F4 also show a pattern similar to a normal distribution with a majority of exterior platform angles falling between 80 and 85 degrees. Comparing the platform angles between the focus areas does not provide any information as the angles vary within the areas themselves, showing a large range of angles (Fig. 132).

Focus area	Measur.	Min.	1st Qu.	Med.	Mean	3rd Qu.	Max.	SD	N
1	Height (L)	14.80	23.80	25.80	28.43	34.30	42.60	7.59509	27
	Width (B)	8.40	13.45	15.00	*15.37*	16.45	27.40	4.166609	27
	Length (D)	15.60	22.05	27.70	*28.97*	34.90	51.70	8.4517	27
2a	Height (L)	6.60	29.35	36.40	36.37	41.85	75.90	10.08748	171
	Width (B)	12.40	19.75	23.00	23.46	27.10	38.70	5.425991	171
	Length (D)	5.60	37.45	52.75	**51.97**	64.67	105.10	19.3085	163
2b	Height (L)	11.40	37.00	44.35	42.75	47.55	62.10	9.019355	62
	Width (B)	16.50	22.90	25.30	26.36	28.70	42.60	5.912362	62
	Length (D)	15.90	39.27	48.05	49.78	59.35	83.30	13.90116	62
3	Height (L)	13.70	17.70	21.40	*22.59*	26.00	37.20	5.997732	77
	Width (B)	9.80	16.02	18.85	19.36	21.65	39.10	4.950625	78
	Length (D)	3.10	19.90	29.75	31.10	40.38	101.80	17.16471	78
4	Height (L)	24.60	37.70	42.60	**44.83**	51.50	69.50	9.766969	47
	Width (B)	17.50	24.65	28.00	**27.84**	31.45	36.90	5.038363	47
	Length (D)	26.9	36.2	42.7	43.7	49.8	66.4	10.15523	45

Table 50. Comparing core sizes (height, width and length) in all focus areas. The largest mean values are marked in bold and the smallest values are marked in italic.

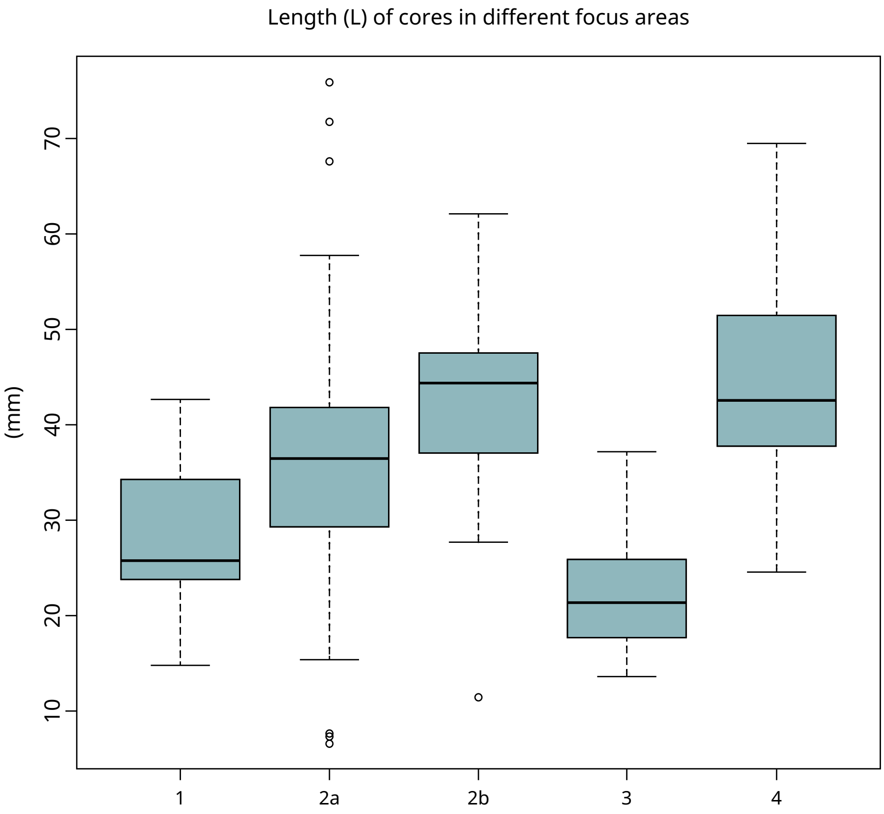
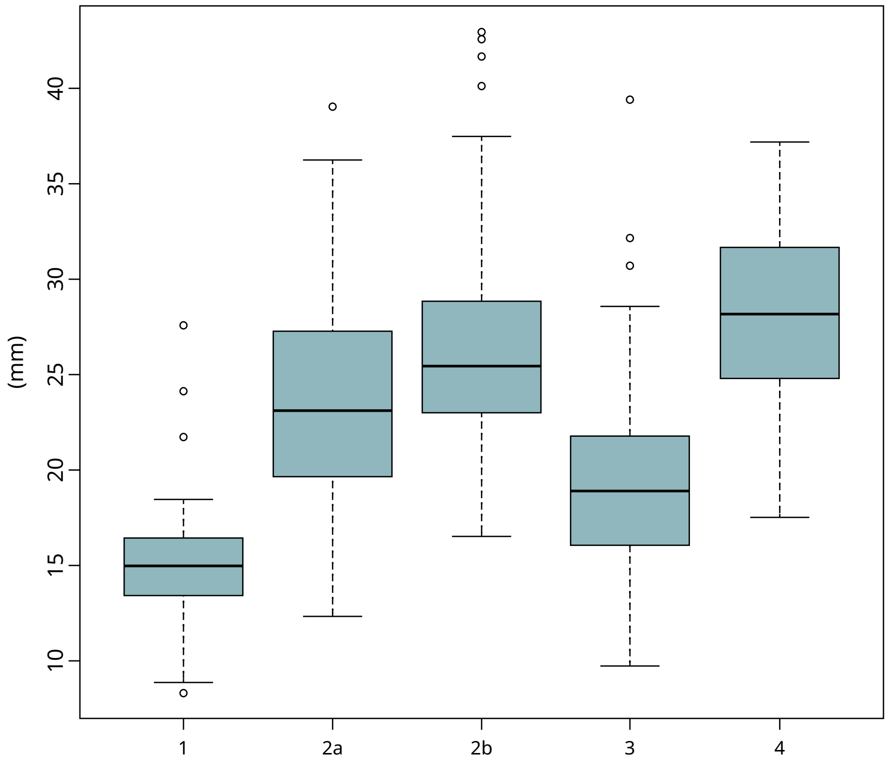
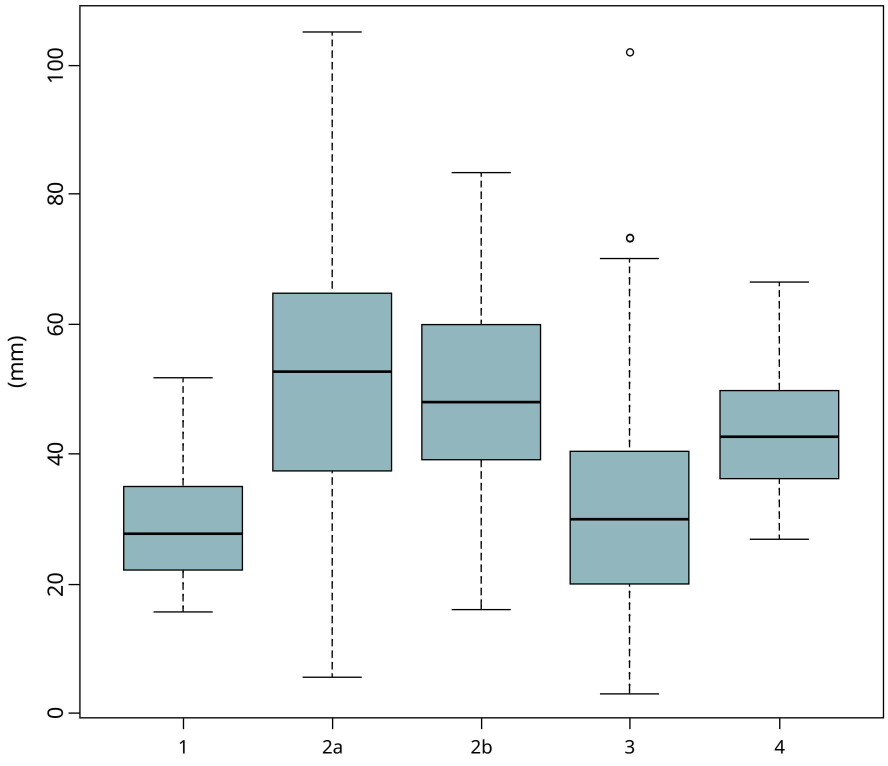


Figure 133 (continued on following page). Boxplots of core height (L), width (B) and thickness (D) measured in millimetres in the different focus areas. Mean values and interquartile ranges are shown in Table 50.

Width (B) of cores in different focus areas



Thickness (D) of cores in different focus areas



Core sizes – Length (L), width (B) and thickness (D)

When studying the mean measurements (Table 50; Fig. 133) from the different areas, some patterns are observable. The cores from F4 have both the largest mean height (L) and mean width (B). The largest mean length (D) is instead found in focus area 2a. The cores from focus area 2b are, however, only slightly smaller than the cores from F4, but with a larger average length (D). The smallest mean width (B) and length (D) are found in F1, although the lowest average core height is found in focus area 3. The average width (B) and length (D) of cores from F3 are, however, slightly larger than in F1.

Some observations can be made regarding the standard deviations in the different focus areas. Firstly, core width (B) is the measurement that varies the least, thus having a low standard deviation, both when comparing measurements within each focus area, but also across the entire research area. Secondly, core length (D) often has the highest SD within each focus area, indicating that core length varies more than core height or width in most cases. This does not hold true for the cores from focus area 1 and 4, which have very similar SD for both height and length.

As seen in figure 133, the cores from focus areas 1 and 3 are generally smaller in size compared to the other focus areas. The cores from F1 are taller but narrower than the cores from F3, while the cores from F3 are shorter but wider. The height and width of cores in F2a, F2b and F3 are rather similar. The largest cores (here relating to height and width) are found in F4, followed by F2b and F2a. All the focus areas, however, show positive correlations between the height and width of the cores, which indicates that taller cores are generally wider.

The cores from F1 prove to be the smallest compared to the other research areas, both relating to height and length. The cores from F3 exhibit the smallest height (L), although they show a rather large span with respect to length (D). The cores from F2a have the highest values for length (D), followed by F3, F2b and F4. The data from the different areas shows some positive relationships, mainly among the cores from F1, F2a and F3. The cores from F2b and F4, however, seem to have a less clear relationship between the measurements.

Again, focus area 1 stands out due to the many small cores from here. The remaining focus areas all show similar patterns with only slight differences in length and width. What is also clear is that all assemblages show a positive linear correlation between the measurements, meaning that as the length of the core increases, the width of the core also increases.

6.1.2.2 Comparing blades

To compare the assemblages regionally, the data from each focus area has been combined and is presented as belonging to one of the focus areas (F2a, F2b and F3). The same attributes are used as a base for comparisons.

To understand the techniques and methods used in the production of these blades, the characteristics of these blade assemblages are compared to experimentally produced and recorded blades (Chapter 7).

Dorsal blade face (DBF)

In all the three focus areas, the same two attribute variations dominate, namely two dorsal blade faces and three dorsal blade faces (Fig. 134).

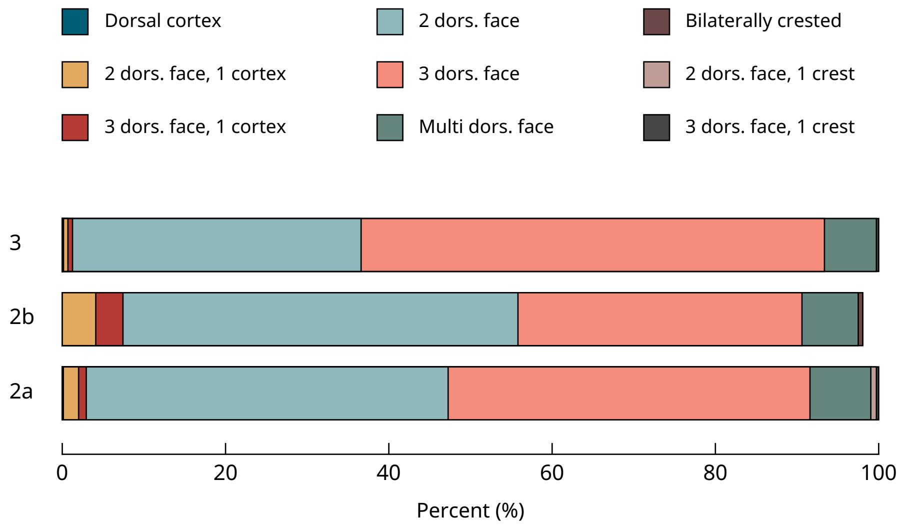


Figure 134. Dorsal blade face (DBF) on recorded blades from focus areas 2a, 2b and 3.

In focus area 2a, almost equal amounts of blades have two or three dorsal blade faces (44.4% and 44.3%). Dorsal blade faces with the presence of cortex were found on 3% of the blades, mainly in the form of two dorsal blade faces with one of them bearing cortex. Multidorsal blade faces were found on 7.3% of the blades and the presence of a crest was found on 1% of the blades.

In focus area 2b, there is a larger number of blades with two dorsal blade faces (48.3%) compared to blades with three dorsal blade faces (34.7%). The presence of cortex is found on 7.7% of blades, mainly as either two or three dorsal blade faces with one face that has cortex. The blades with multidorsal blade faces amount to 6.8%. The presence of a crest was found on 2.5% of the blades.

In focus area 3, there are more blades that display three dorsal blade faces (56.6%) compared to two dorsal blade faces (35.3%). The presence of cortex is comparatively low, amounting to only 1.3% of the blade assemblage. Blades with multidorsal blade faces amount to 6.5%. Crests are very uncommon, with only one example in the whole assemblage (0.3%).

Blade termination 1 (BT1) and blade termination 2 (BT2)

In all focus areas, the most common blade termination is characterised by a broken/non-remaining termination (Fig. 135). In focus area 2a, 57.4% of the blades do not have remaining distal ends. Similarly, the blades from focus area 2b have non-remaining distal ends in 54.1% of the cases. In focus area 3, 80.3% of the blades have broken/non-remaining distal ends.

The second most common termination in all assemblages is an ideal ending. These amount to 25.5% in F2a, 27.5% in F2b and 17.4% in F3.

The presence of prematurely terminated blades, in the form of feathering, is also common in the assemblages from F2a (15%) and F2b (15.1%), but is much less common in focus area 3 (1.8%).

Prematurely terminated blades also appear in F2a as plunged (0.4%) or hinged (1.7%) termination. Similarly, small amounts of blades from F2b show terminal plunging (1.5%) and hinging (1.8%). In focus area 3, these attributes are extremely rare, with only single examples of plunging and hinging.

The shape of the distal ends from each focus area is almost equally divided between pointed and straight ends, with a slight tendency towards pointed blades

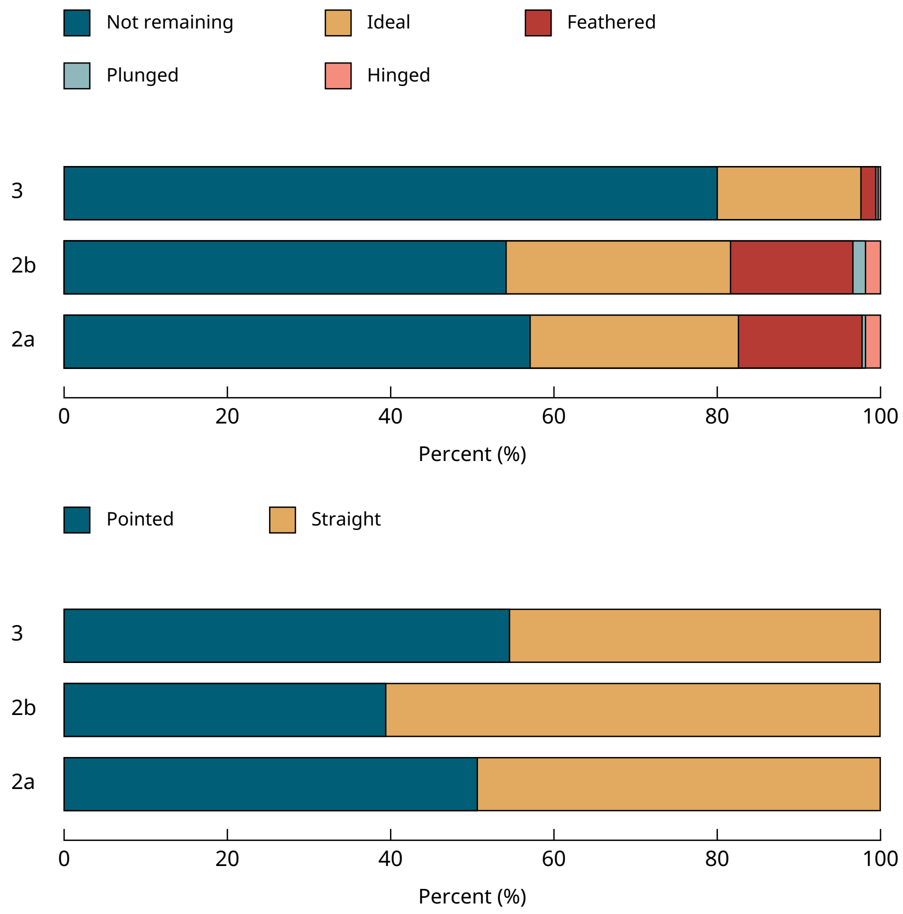


Figure 135. Blade termination 1 (BT1, first bar graph) and blade termination 2 (BT2, second bar graph) on recorded blades from focus areas 2a, 2b and 3.

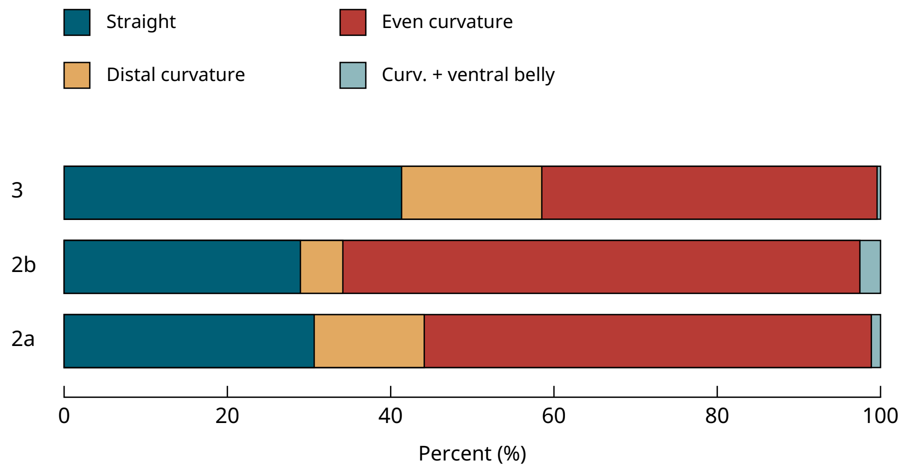


Figure 136. Blade curvature (CURV) on recorded blades from focus areas 2a, 2b and 3.

in focus area 2a (50.7% *vs.* 49.3%) and focus area 3 (54.7% *vs.* 45.3%). In focus area 2b, there is instead a slight tendency towards straight ends (60.4% *vs.* 39.6%).

Blade curvature (CURV)

Some slight regional differences can be found with relation to the curvature of the blades in the different focus areas (Fig. 136).

In focus area 2a, most of the blades have an even curvature (54.5%) followed by straight blades (30.6%) and blades with distal curvature (13.6%). A small percentage of blades have curvature in combination with a ventral belly (1.2%).

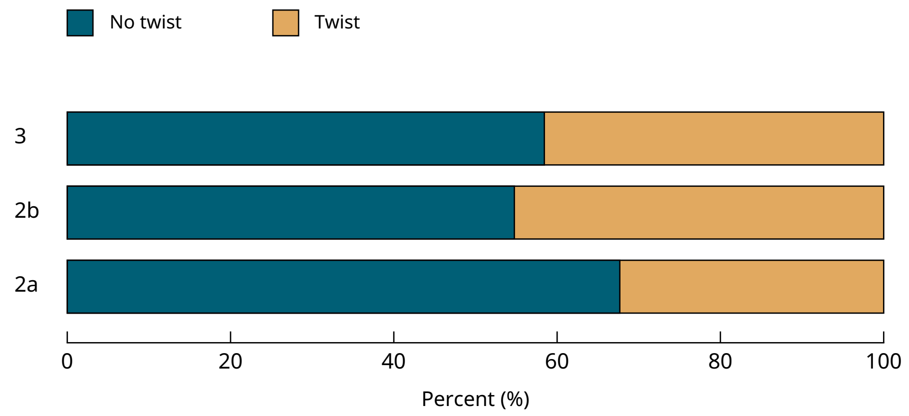


Figure 137. Blade twist (TWIST) on recorded blades from focus areas 2a, 2b and 3.

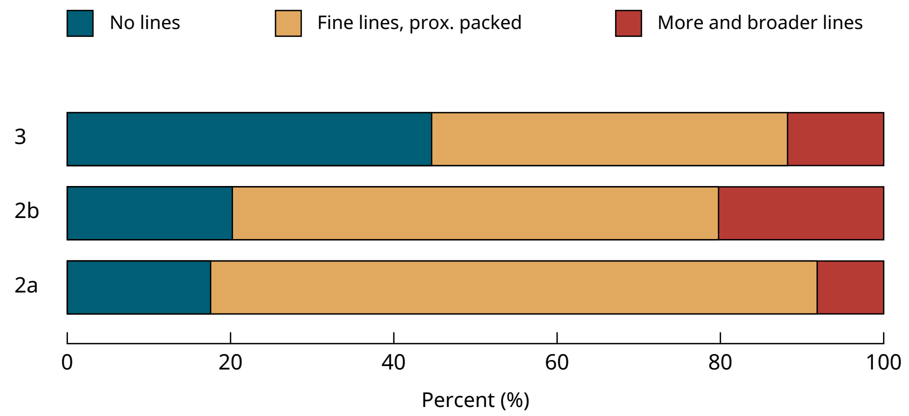


Figure 138. Wallner lines (WN) on recorded blades from focus areas 2a, 2b and 3.

In focus area 2b, most blades also have an even curvature (63.2%), followed by straight blades (29%) and distally curved blades (5.2%). A small percentage of blades have curvature in combination with a ventral belly (2.6%).

In focus area 3, straight blades and evenly curved blades are instead equally common (each 41.2%), followed by a larger amount of distally curved blades (17.2%), compared to the other two areas. Only one blade has curvature and a ventral belly.

Blade twist (TWIST)

Twisted and non-twisted blades appear in all focus areas, although it is slightly more common for blades to have no twist (Fig. 137). In focus area 2a, non-twisted blades amount to 67.9%. In focus area 2b, they amount to 54.9% and in focus area 3 non-twisted blades make up 58.8% of the blade assemblage.

Wallner lines (WN)

In focus area 2a, blades most commonly display fine, proximally packed Wallner lines (74.4%), followed by blades without any Wallner lines (17.6%) and pronounced Wallner lines (8%; Fig. 138).

A similar pattern is seen in focus area 2b, where most blades also display fine, proximally packed Wallner lines (59.5%), followed by equal numbers of blades without Wallner lines (20.2%) and those with pronounced Wallner lines (20.2%).

The pattern differs slightly in focus area 3, where blades most commonly lack Wallner lines (44.8%), followed by blades with fine, proximally packed Wallner lines (43.5%) and pronounced Wallner lines (11.8%).

Blade regularity (REG)

Blade regularity is very similar in all focus areas (Fig. 139). Most of the blades in each assemblage are regular, with amounts ranging between 74.3% and 76.1%. This is followed by the presence of irregular blades, which amount to 16.3% in F2a, 15.7% in F2b and 18.7% in F3. Extremely regular blades are only found in smaller amounts, specifically 7.6% in F2a, 8.7% in F2b and 7% in F3.

Platform preparation dorsal (SFPD)

The method for dorsal blade preparation is different in the various focus areas (Fig. 140). In focus area 2a, most blades were prepared using a combination of trimming and abrasion (35.2%), closely followed by trimming (29.9%) and abrasion (29.2%). A small portion of the assemblage lacks any dorsal preparation (5.7%).

In focus area 2b, most blades were also prepared using a combination of abrasion and trimming (46.6%), followed by trimming (32.8%), and a smaller number of blades with abrasion (12.8%) and a lack of preparation (7.9%).

In focus area 3, however, most blades were prepared using trimming (69.9%), followed by smaller amounts of blades that lack preparation (13.9%), those with trimming and abrasion (8.6%) and those only with abrasion (7.6%).

Platform preservation (SFPE)

In all focus areas, smooth platforms are the most common attribute variation. Faceting appears in different amounts across the research areas (Fig. 141).

In focus area 2a, smooth platforms are especially dominating, appearing on 94.8% of the blades. The remaining percentage is made up of blades with faceted platforms with two facets (3%), crushed platforms (1.6%) and platforms with cortex (0.5%).

In focus area 2b, most of the blades have smooth platforms (76.8 %), followed by crushed platforms (10.7%), faceted platforms with two facets or more (10.1%), not preserved platforms (2%) and platforms with cortex (0.3%).

In focus area 3, most blades also have smooth platforms (68.8%). A significant proportion of the assemblage is made up of blades with faceted platforms with two platforms (21.2%), or with more than two platforms (5.1%). Blades with not remaining platforms make up 1.1% of the assemblage.

Conus formation (KE)

Most blades within each focus area lack any form of conus formation (Fig. 142). In focus area 2a, 83% of the blades lack conus formation. The remaining blades have existing conus formation (14.3%) or conus formation visible only on the platform (2.6%). Only one blade has a double conus formation (0.1%).

In focus area 2b, 73.7% of blades lack conus formation while 22.9% display it. Additionally, 2.7% of blades have conus formation only visible on the platform and two blades have a double conus formation (0.8%).

In focus area 3, 90.7% of the blades lacks conus formation while the rest exhibits conus formation.

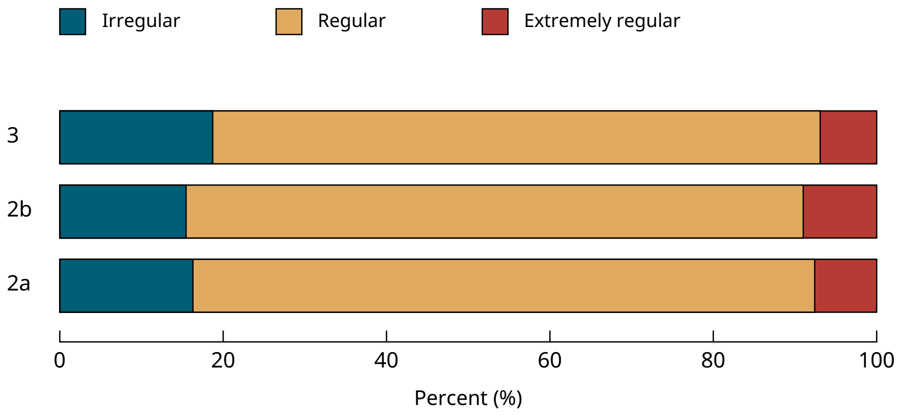


Figure 139. Blade regularity (REG) on recorded blades from focus areas 2a, 2b and 3.

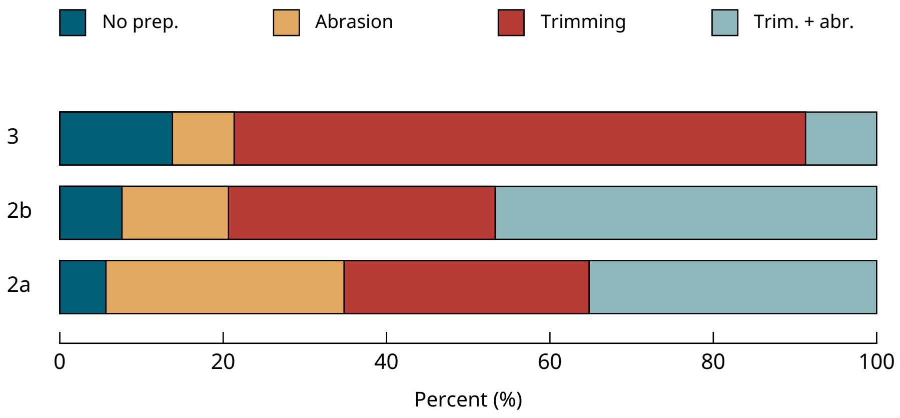


Figure 140. Platform preparation dorsal (SFPD) on recorded blades from focus areas 2a, 2b and 3.

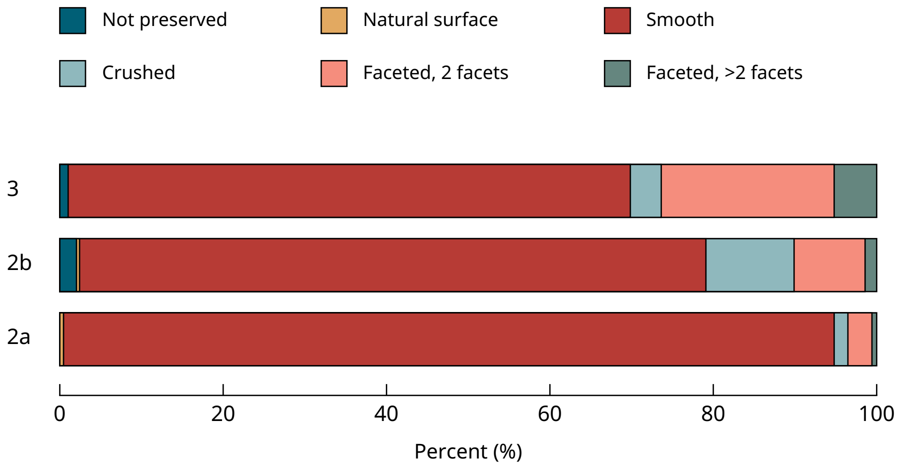


Figure 141. Platform preservation (SFPE) on recorded blades from focus areas 2a, 2b and 3.

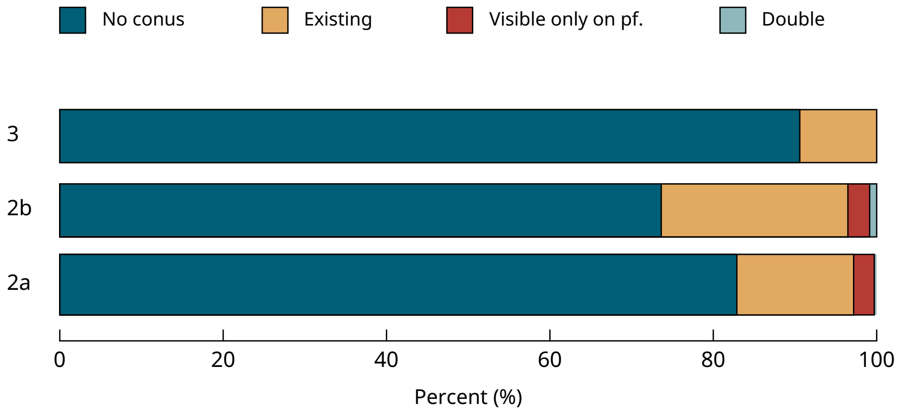


Figure 142. Conus formation (KE) on recorded blades from focus areas 2a, 2b and 3.

Focus area	Measur.	Min.	1st Qu.	Med.	Mean	3rd Qu.	Max.	SD	n
2a	Platform width (SFRD)	0.600	2.200	2.800	3.087	3.500	12.000	1.416448	17
	Platform thickness (SFRK)	0.300	0.800	1.000	1.170	1.400	4.700	0.5658177	17
2b	Platform width (SFRD)	0.900	2.800	3.900	**4.273**	5.300	26.900	2.341539	78
	Platform thickness (SFRK)	0.500	0.900	1.300	**1.458**	1.900	4.500	0.69047	79
3	Platform width (SFRD)	0.900	2.100	2.600	*2.685*	3.100	5.500	0.8456589	14
	Platform thickness (SFRK)	0.400	0.800	1.000	*1.051*	1.200	2.500	0.3424363	14

Table 51. Platform width (SFRD) and platform thickness (SFRK) of blades from focus areas 2a, 2b and 3. The largest mean values are marked in bold and the smallest values are marked in italic.

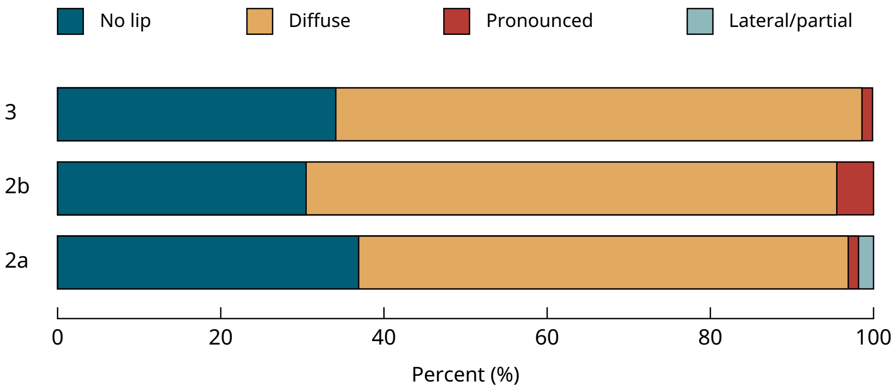


Figure 143. Lip (SL) on recorded blades from focus areas 2a, 2b and 3.

Lip (SL)

The most common lip attribute variation from all focus areas is the presence of a diffuse lip (Fig. 143). In focus area 2a, a diffuse lip is found on 60% of the blades. The remaining blades lack a lip (37%), have a partial lip (1.6%) or a pronounced lip (1.4%).

Among the blades in focus area 2b, 65% have diffuse lips, while 30.7% lack lip formation. The remaining 4.4% have pronounced lips.

The assemblage from focus area 3 contains 64.4% of blades with diffuse lips, followed by no lip formation (34.2%). The remaining portion (1.3%) has pronounced lips.

Platform width (SFRD) and platform thickness (SFRK)

The largest mean values for platform width and thickness both come from focus area 2b, followed by focus area 2a. The smallest platforms are found among the blades from focus area 3.

The standard deviation relating to platform width and thickness are the highest in the dataset from F2b. The dataset with the least amount of standard deviation, relating to both width and thickness of platforms, comes from focus area 3. The same pattern can be seen for platform widths and thicknesses, with the most variety in F2b, followed by 2a and lastly F3 (Table 51).

Focus area	Measur.	Min.	1st Qu.	Med.	Mean	3rd Qu.	Max.	SD	n
2a	Length (L)	3.40	16.50	21.30	23.71	27.15	133.10	12.5544	331
	Width (B)	2.000	5.300	6.300	7.206	7.800	27.500	3.387775	742
	Thickness (D)	0.500	1.100	1.400	1.678	1.875	10.500	1.028075	742
2b	Length (L)	5.60	26.05	31.90	**34.91**	43.25	67.50	12.01945	131
	Width (B)	4.80	8.10	10.85	**11.79**	15.25	25.30	4.41352	342
	Thickness (D)	1.100	2.100	2.900	**3.067**	3.800	9.300	1.255833	342
3	Length (L)	11.30	16.75	19.50	*19.83*	22.30	31.80	4.403493	75
	Width (B)	3.500	5.300	6.100	*6.241*	7.100	10.900	1.269897	385
	Thickness (D)	0.600	1.100	1.400	*1.465*	1.600	6.600	0.5933148	385

Table 52. Blade sizes for blades from focus areas 2a, 2b and 3. The largest mean values are marked in bold and the smallest values are marked in italic.

Blade length (L), width (B), thickness (D)

The size of the blades generally mirrors the platform sizes (Table 52). The largest blades (based on mean measurements of L, B and D) come from focus area 2b. The second largest blades are found in focus area 2a, while the smallest blades come from focus area 3.

The most homogenous assemblage is from focus area 3, as displayed by significantly lower standard deviations (for L, B and D) than in the other two groups. The standard deviation for blade length is almost the same in focus area 2a and 2b, although slightly higher in F2a. Instead, the standard deviation relating to blade width is somewhat larger in focus area 2b.

When the length, width and thickness of the blades are plotted in a scatterplot (Fig. 144), the finds can be studied both individually and as a group. The scatterplots visualise the observations that were already made from the table. Only complete blades were used in the making of the scatterplots.

6.1.3 Statistical testing and multivariate analyses

Statistical tests and multivariate analyses were used to further describe the patterns observed during the descriptive statistical investigations. The relationship between different observed attributes and the focus areas was investigated to understand if certain attributes are more relevant in certain areas, which would be indicative of regional technological traditions. Nominal (qualitative) data was dealt with separately from metric (quantitative data). P-values were calculated as a statistical measure of probability to obtain the observed results, assuming that a null-hypothesis is true. Here, *p*-values below 0.05 were considered significant.

6.1.3.1 The cores: Fisher's exact test

The results of the Fisher's exact test (Table 53), which investigates the relationship between the focus areas and the different attributes, show that most attributes have significant associations to the focus areas, which indicate that the data is not random. Only the attributes that relate to core front design (KAAN) and core side 1 (KS1) are likely (probability above 5%) to lack an association with the focus

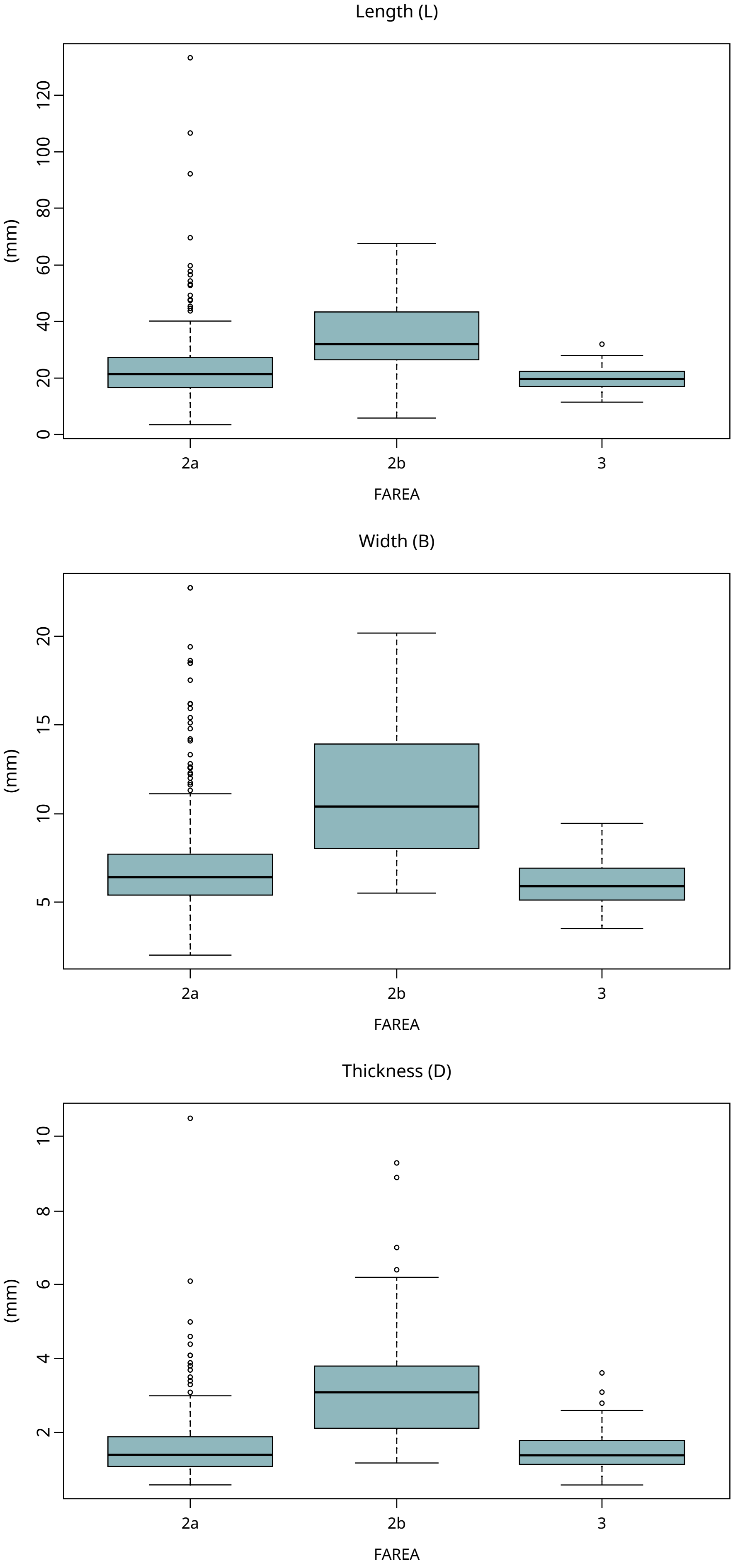


Figure 144. Boxplots of blade length (L), width (B) and thickness (D) measured in millimetres in focus areas 2a, 2b and 3. Mean values and interquartile ranges are shown in Table 52.

Attribute	p-value	Accept/reject null	Comment
KAAN	0.120	Accept	
KSFA	0.036	Reject	
KSFN	0.032	Reject	
HCF	0.011	Reject	with simulated p-value (based on 2000 replicates)
KR	0.049	Reject	with simulated p-value (based on 2000 replicates)
KS1	0.083	Accept	with simulated p-value (based on 2000 replicates)
KS2	< 0.001	Reject	with simulated p-value (based on 2000 replicates)
EPANG	0.010	Reject	with simulated p-value (based on 2000 replicates)
PMORPH	< 0.001	Reject	with simulated p-value (based on 2000 replicates)
PPCD	< 0.001	Reject	with simulated p-value (based on 2000 replicates)
KS_comb	< 0.001	Reject	with simulated p-value (based on 2000 replicates)

Table 53. The results of the Fisher's exact test for testing associations between attributes and focus areas. P-values are rounded to three decimal places.

No.	Meaning
11	cortex + cortex
12	cortex + flake negatives/one large negative
13	cortex + lateral edge preparation
21	flake negatives/one large negative + cortex
22	flake negatives/one large negative + flake negatives/one large negative
23	flake negatives/one large negative + lateral edge preparation
31	lateral edge preparation + cortex
32	lateral edge preparation + flake negatives/one large negative
33	lateral edge preparation + lateral edge preparation

Table 54. The combined attributes of KS1 and KS2 were termed KS_comb, here listed with attribute varieties.

areas. These attributes might therefore show a random pattern and are thus not suited for highlighting regional technological variations.

Certain attributes are more strongly associated with one or more research areas, as shown by extremely low p-values (< 0.001). These attributes are core side 2 (KS2), platform morphology (PMORPH) and platform preparation dorsal (PPCD). The very low p-values indicate that these attributes have strong associations with the focus areas, making them interesting for further investigation.

The result that KS1 had a very low probability of association with the research areas while KS2 had a high association (above 0.05) was unexpected since the two attributes basically map the same attribute, only on separate sides of the core. However, the higher p-value for KS2 is not exceptionally higher than the 0.05-limit and the recorded attributes for KS1 and KS2 are similar, as shown in figure 129, which lead to the decision to combine the two attributes into one. The combined attribute of KS1 and KS2 was termed KS_comb (attribute morphologies

Table 55. Expected and observed values for the KAAN attribute variations (1-3). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 cores, while a stronger yellow/green colour represents differences with more than 10 cores.

	Expected				**Observed**			
		1	**2**	**3**		**1**	**2**	**3**
KAAN	**1**	25	1	1	**1**	23	0	4
	2a	140	5	7	**2a**	138	6	8
	2b	26	1	1	**2b**	27	0	1
	3	56	2	3	**3**	59	1	1
	4	43	1	2	**4**	44	3	0

Table 56. Expected and observed values for the KSFA attribute variations (1-2, 5) and the KSFN attribute variations (1-2, 5). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 cores, while a stronger yellow/green colour represents differences with more than 10 cores.

	Expected				**Observed**			
		1	**2**	**5**		**1**	**2**	**5**
KSFA	**1**	26	0	1	**1**	25	2	0
	2a	157	1	4	**2a**	158	0	4
	2b	29	0	1	**2b**	30	0	0
	3	73	1	2	**3**	74	0	1
	4	45	0	1	**4**	43	1	3

	Expected				**Observed**			
		1	**2**			**1**	**2**	
KSFN	**1**	26	1		**1**	25	2	
	2a	154	4		**2a**	156	2	
	2b	29	1		**2b**	30	0	
	3	65	2		**3**	66	1	
	4	46	1		**4**	43	4	

Table 57. Expected and observed values for the HCF attribute variations (0-2). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 cores, while a stronger yellow/green colour represents differences with more than 10 cores.

	Expected				**Observed**			
		0	**1**	**2**		**0**	**1**	**2**
HCF	**1**	23	2	1	**1**	19	4	3
	2a	133	12	9	**2a**	124	17	12
	2b	19	2	1	**2b**	22	0	0
	3	63	6	4	**3**	68	2	3
	4	41	4	3	**4**	45	2	0

combined as seen in Table 54). The results of the Fisher's exact test on the attribute KS_comb also resulted in a low p-value (< 0.001) and thus a strong association with the research areas.

6.1.3.2 The cores: Expected and observed frequencies

As indicated by the higher p-value for the attribute KAAN (*P*=0.120), it shows little association with the focus areas. KS1 will not be discussed here as it was replaced by attribute KS_comb and will be discussed later in this chapter. A small number of cores exceeded the expected values for the presence of two opposing core fronts in focus area 1. In focus area 3, there is instead a slightly higher number of observed cores that have one core front than expected. The small relative difference between the expected and observed values, however, indicates that these patterns are rather insignificant (Table 55).

The p-values for KSFA (0.036) and KSFN (0.032) were both below 0.05, and thus indicate an association between the attributes and the focus areas. However, the p-values are not very low, compared to several of the other attributes, which would indicate that the associations are not very strong. This is also reflected in the comparisons between the expected and observed values shown in the contingency table (Table 56). The only slight difference between the frequencies can be found among the cores from F4, whereby fewer cores than expected had one single platform.

The p-value for attribute HCF (*P*=0.011) is below 0.05 and can thus be assumed to have an association to the focus areas. When comparing the expected and observed values, some observations can be made. In focus area 1, there are fewer cores made from nodules (attribute variation 0) than expected. In focus area 2a, a similar trend is found, with both lower frequencies of cores made from nodules than expected, as well as higher frequencies of cores made from flakes than expected. For focus areas 2b, 3 and 4, the opposite relationship can be seen with more cores than expected being made from nodules and fewer than expected that are made from flakes (Table 57).

The p-value for KR (*P*=0.049) is below the limit of 0.05, but only minimally, indicating that there is a rather weak association between this attribute and the focus areas. A comparison of the expected and observed values shows that the number of observed cores with cortex on the back is lower than the expected value. Instead, the number of observed cores with flake negatives are somewhat higher than expected. The same pattern can be seen in focus area 3. The opposite trend is seen among the Lithuanian cores. Here we find a larger number of cores that have unprepared backs (with remaining cortex) than what was expected, and a much smaller number of cores with flake negatives (Table 58).

The p-value relating to KS_comb (p-value < 0,001) is very low, indicating a stronger type of relationship between the attribute and the focus areas. A comparison between expected and observed frequencies shows that cores from focus area 1 exhibit a higher number with attribute variation 22 than expected (Table 59). There are also slightly smaller numbers of observed cores with attribute variation 33 and cores with any presence of cortex (attribute morphs 11, 12 or 13).

In focus area 2a, there are higher observed frequencies of cores with attribute variations 22 and 32.

In focus area 2b, there are, in contrast, lower frequencies of observed cores with any combination of flake removals/one large negative preparation (attribute morphologies 21, 22 or 23) as well as a lower number of observed cores with attrib-

Table 58. Expected and observed values for the KR attribute variations (1, 3-4). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 cores, while a stronger yellow/green colour represents differences with more than 10 cores.

		Expected				Observed		
		1	**3**	**4**		**1**	**3**	**4**
KR	**1**	7	15	0	**1**	4	19	0
	2a	43	93	2	**2a**	42	92	4
	2b	7	15	0	**2b**	7	16	0
	3	17	36	1	**3**	12	42	0
	4	13	29	1	**4**	23	20	0

		Expected								
		11	**12**	**13**	**21**	**22**	**23**	**31**	**32**	**33**
KS_comb	**1**	0	1	1	2	8	3	0	3	3
	2a	3	7	6	10	53	16	2	18	18
	2b	1	3	2	4	19	6	1	7	6
	3	1	3	3	5	24	8	1	8	8
	4	1	2	2	3	14	4	1	5	5
		Observed								
		11	**12**	**13**	**21**	**22**	**23**	**31**	**32**	**33**
	1	2	2	1	3	14	1	0	3	0
	2a	3	7	8	12	58	17	2	24	17
	2b	0	0	1	1	6	3	1	1	9
	3	0	2	3	2	19	13	1	9	13
	4	2	5	1	5	22	3	1	4	1

Table 59. Expected and observed values for the KS_comb attribute variations (11-13, 21-23, 31-33). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 cores, while a stronger yellow/green colour represents differences with more than 10 cores.

ute variation 32. Interestingly, cores with double-sided lateral edge preparation (attribute morph 33) are found in higher frequencies than expected. There are also slightly smaller number of cores with remaining cortex (attribute morph 11, 12 or 13) than expected.

In focus area 3, there are lower than expected observed frequencies of cores with attribute variation 21 and 22. There are also higher than expected frequencies of cores with attribute variation 23 and 33.

In focus area F4, there are higher than expected frequencies of cores with attribute variation 22 and lower than expected amounts of attribute variation 33. These patterns, along with the low p-value, indicate that the attribute should go on to be further investigated in the multivariate analyses.

The p-value for attribute EPANG (0.010) is lower than 0.05, which indicates an association to the focus areas. However, the p-value is higher than many of the other investigated attributes and therefore seems less relevant for an understanding of the technological trends in the focus areas. A comparison of the expected

		Expected														
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	**105**	**110**	**115**	**120**
EPANG	**1**	0	0	0	1	2	4	4	5	4	3	2	1	0	0	0
	2a	0	1	1	6	8	19	21	26	23	18	9	3	1	1	0
	2b	0	0	0	2	3	7	8	9	8	6	3	1	0	0	0
	3	0	0	0	2	3	8	8	10	9	7	4	1	0	0	0
	4	0	0	0	2	3	6	7	8	7	5	3	1	0	0	0
		Observed														
		50	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	**105**	**110**	**115**	**120**
	1	0	2	0	1	4	5	4	4	4	3	0	0	0	0	0
	2a	0	0	0	4	4	22	17	27	24	19	13	4	2	1	1
	2b	0	0	0	1	5	2	12	8	11	3	5	2	0	1	0
	3	1	0	2	8	3	10	6	10	6	8	1	0	0	0	0
	4	0	0	0	0	3	5	9	10	7	7	1	1	0	0	0

Table 60. Expected and observed values for the EPANG attribute variations (50-120). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 cores, while a stronger yellow/green colour represents differences with more than 10 cores.

	Expected				Observed			
		1	**2**	**3**		**1**	**2**	**3**
PMORPH	**1**	16	12	2	**1**	3	25	1
	2a	86	64	10	**2a**	88	63	9
	2b	32	24	4	**2b**	51	3	6
	3	39	29	5	**3**	48	19	6
	4	27	20	3	**4**	9	39	2

Table 61. Expected and observed values for the PMORPH attribute variations (1-3). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 cores, while a stronger yellow/green colour represents differences with more than 10 cores.

and observed values also does not show many strong differences (Table 60). There is no clear trend, *e.g.*, between smaller or larger angles that can to be observed from these differences.

The two attributes PMORPH and PPCD show the strongest relation to the focus areas (both with $P < 0.001$), along with the attribute KS_comb. This stronger relation can also be seen in the large differences in frequencies, highlighted by the strong colours in the table below. Through a comparison between expected and observed frequencies, we get an idea about which attribute morphologies relate to which focus area.

In focus area 1, there is a significantly lower number of cores with smooth platforms than expected. Additionally, there are much higher frequencies of cores with facetted platforms in the area. The same pattern is observed for the materials

		Expected						Observed						
		0	**1**	**2**	**3**	**4**	**5**		**0**	**1**	**2**	**3**	**4**	**5**
PPCD	**1**	3	2	19	4	2	2	**1**	5	0	13	1	7	6
	2a	14	8	91	21	9	7	**2a**	10	17	79	44	0	0
	2b	6	3	36	8	4	3	**2b**	6	1	49	3	0	0
	3	6	3	39	9	4	3	**3**	8	1	54	1	0	0
	4	5	3	30	7	3	2	**4**	4	0	20	0	14	11

Table 62. Expected and observed values for the PPCD attribute variations (0-5). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 cores, while a stronger yellow/green colour represents differences with more than 10 cores.

Area	p-value (L)	normal dist.	p-value (B)	normal dist.	p-value (D)	normal dist.
F1	0.09258	yes	0.0182	no	0.2647	Yes
F2a	0.000331	no	0.2495	yes	0.1314	Yes
F2b	0.1117	yes	0.001395	no	0.3253	Yes
F3	0.002902	no	0.001688	no	0.00231	No
F4	0.6639	yes	0.2182	yes	0.295	Yes

Table 63. Results of the Shapiro-Wilk normality test. Values above 0.05 indicate normally distributed datasets.

from F4. In focus area 2a, the expected and observed values closely align. For focus areas 2b and 3, there is instead a significantly larger number of observed cores with smooth platforms. Here, there are instead much lower numbers of cores with faceted platforms than expected (Table 61). Thus, cores with smooth platforms are overrepresented in focus areas 2b and 3, while cores with faceted platforms are overrepresented in focus area 1 as well as among the assemblages from F4.

When it comes to the comparison between expected and observed values relating to the attribute PPCD, several trends can be observed (Table 62). In focus area 1, there are fewer cores than expected that have trimming, abrasion or a combination of the two. Instead, cores with trimming and/or abrasion on top of the platform are more common than expected.

In focus area 2a, there are fewer cores than expected that lack platform preparation. The same is true for cores with trimming, as well as cores with trimming and/or abrasion on top of the platform. In the same area, there are instead higher frequencies of cores with abrasion and a combination of trimming and abrasion than expected.

In focus area 2b and 3, a higher frequency of cores with trimming than expected are observed. Lower than expected numbers of cores have trimming and abrasion, in combination, or any form of platform preparation on top of the platform.

Among the cores from F4, there are lower amounts of trimming, abrasion or a combination of them than expected. Instead, there are higher numbers of cores with platform preparation located on top of the platform than expected.

Core height (L)				
	1	2a	2b	3
2a	< 0.001	-	-	-
2b	< 0.001	< 0.001	-	-
3	0.003	< 0.001	< 0.001	-
4	< 0.001	< 0.001	**1.000**	< 0.001
Core width (B)				
	1	2a	2b	3
2a	< 0.001	-	-	-
2b	< 0.001	0.020	-	-
3	0.001	< 0.001	< 0.001	-
4	< 0.001	< 0.001	**0.345**	< 0.001
Core length (D)				
	1	**2a**	**2b**	**3**
2a	< 0.001	-	-	-
2b	< 0.001	**1.000**	-	-
3	**1.000**	< 0.001	< 0.001	-
4	< 0.001	0.014	**0.263**	< 0.001
P value adjustment method: Bonferroni				

Table 64. Results of the Wilcoxon rank sum test for core sizes. The p-values were adjusted using the Bonferroni-method and are rounded to three decimal places. Values higher than 0.05 are marked in bold.

6.1.3.3 The cores: Shapiro-Wilk test and Wilcoxon rank sum test (core sizes)

Before comparing the height, width and length of the cores in the different focus areas, the character of the data was investigated, starting with the normality of it. The normal distribution of the different datasets (L, B, D in each focus area) was checked using a Shapiro-Wilk test, which showed that 9/15 datasets were normally distributed (Table 63).

Because of the presence of several non-normally distributed datasets, pairwise comparisons using the Wilcoxon rank sum test (Table 64) were used in the following. The p-values were adjusted using the Bonferroni-method. The results of the tests indicate that there is generally some significant variety between core height, width and thickness (based on the low p-values) when compared between the different focus areas. However, the higher p-values for core height (L) in F2b and F4 indicate some similarities in the medians of these datasets. The same pattern can be seen for core width (B) in these areas. More similar medians, in relation to core length (D), could be identified, namely between focus areas 1 and 3, 2a and 2b, as well as 2b and F4.

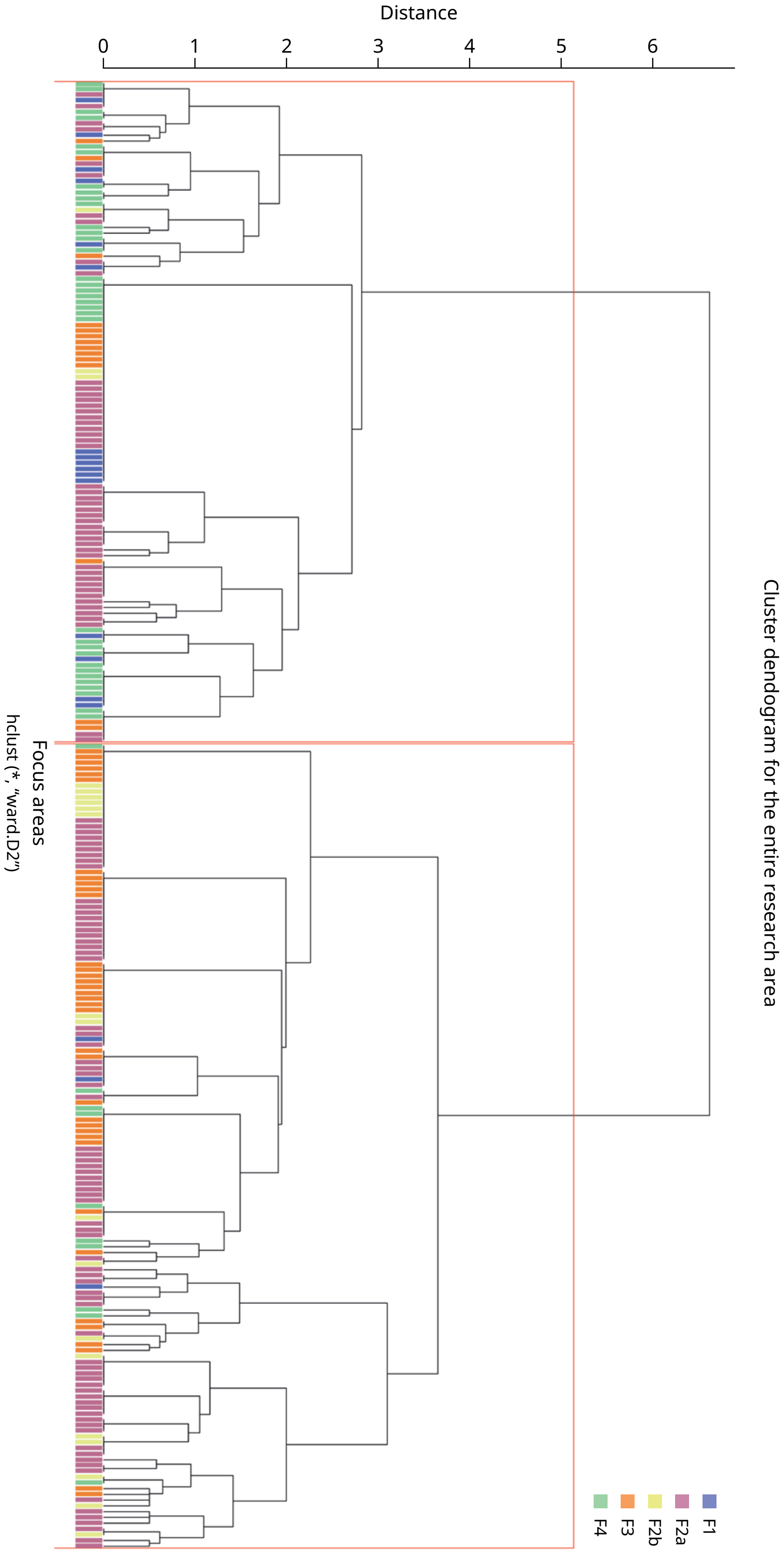


Figure 145. Dendrogram displaying the clustering of sites (coloured according to their focus areas), based on three core attributes (PMORPH, KS_comb and PPCD) recorded within the research area. When the dendrogram is cut at two clusters (red squares), sites from focus areas 1 and 4 are mainly found in cluster 1, while most sites from focus areas 2a, 2b and 3 are found in cluster 2. See supplementary materials for a larger version of the figure.

6.1.3.4 The cores: Cluster analysis

Judging from the results of the Chi-square tests, three attributes stand out as strongly associated with specific regions of the research area, namely PPCD (Platform preparation), PMORPH (Platform morphology) and KS_comb (Core side 1 and 2, in combination). These attributes have clear relations to certain focus areas ($P < 0.001$), as seen by the comparisons of expected and observed frequencies above. These patterns indicate that these three core attributes are relevant for an understanding of technological variations between the focus areas and will therefore be further investigated in a cluster analysis.

The dendrogram resulting from the cluster analysis can be seen in figure 145. To approach a relevant number of clusters (k) for interpretation, several different values of k were investigated. Starting at seven clusters (k=7), the number of cores from each focus area was counted. Subsequently, percentages were calculated for these numbers. The results can be found in Table 65. By sequential analysis of each cluster analysis, several patterns can be observed.

When the dendrogram is cut at **7 clusters**, the cores from F1 mainly fall within clusters (k)1 and 2, followed by k3, although they are also found in k5 and k6. The cores from F2a appear in each cluster, but the highest numbers are found in k5, k3 and k7, which together make up 68.8% of the cores from there. In F2b, most cores fall within k4 and k7, followed by k5. Smaller amounts are also found in the remaining clusters. Cores from F3 are by far the most common in k5, followed by smaller amounts in all other clusters. Finally, the cores from F4 are most common in k1, k3 and k2, also followed by lower amounts in remaining clusters.

When the data is clustered into **6 clusters,** the cores in the previous clusters 4 and 5 merge into one (here k4). Now, the cores from F1 still remain concentrated in k1, k2 and k3 (together making up 84.3% of the cores). The cores from F2a are mainly clustered in k3, k4 and k6 (with a total of 76.2%). Finds from F2b are distributed in k4 and k6 (together 80%), while cores from F3 are highly concentrated in k4 (60%), followed by k2 (16%) and lower amounts in remaining groups. The cores from F4 mainly group in k1 and k3, followed by k2 and k4.

When the dendrogram is cut at **5 clusters,** the cores from previous clusters 2 and 3 merge into one group (now k2). At this point, focus area 1 is concentrated in k1 and k2 (84.2%). F2a remains distributed across k3 and k2, followed by k5 (amounting to 86% of the cores). The cores from F2b also remain focused in k3 and k5 (80%). Cores from F3 are found mainly in k3 (60%), followed by k2 (22%). Meanwhile, the cores from F4 are distributed over k2 and k1 (77.3%), followed by k3 (15.9%).

As data was further clustered into **4 clusters,** the previous clusters 1 and 2 were grouped into one (now k1). At this point, the cores from F1 are mainly found in k1 (84.2%), followed by smaller amounts in k2 and k3. For F2a, the cores are still mainly found in k1, k2 and k4 (now amounting to 94.2%). The cores from F2b are concentrated in k2 (60%), followed by k1 (28%). For F3, the cores are found in k1 (77.3%) and k2 (15.9%).

When the data is clustered into only **3 clusters**, the previous clusters 3 and 4 group into one (now k3). The cores from F1 are still mainly found in k1 (84.2%), followed by smaller amounts in remaining clusters. For F2a, the cores are more evenly distributed between the three clusters, with 39.3% of cores in k1, 34.4% in k2 and 26.2% in k1. In F2b, most cores are found in k2 (50%), followed by k3 (35%) and k1 (15%). Cores from F3 are concentrated in k2 (60%), k1 (28%) and k3

No of clusters	Clus-ters	Absolute numbers						Percentages (%)				
		F1	F2a	F2b	F3	F4	SUM	F1	F2a	F2b	F3	F4
7	k1	6	10	1	3	14	*34*	31.6	8.2	5.0	6.0	31.8
	k2	6	12	2	8	8	*36*	31.6	9.8	10.0	16.0	18.2
	k3	4	26	0	3	12	*45*	21.1	21.3	0.0	6.0	27.3
	k4	0	9	6	6	1	*22*	0.0	7.4	30.0	12.0	2.3
	k5	2	33	4	24	6	*69*	10.5	27.0	20.0	48.0	13.6
	k6	1	7	1	4	2	*15*	5.3	5.7	5.0	8.0	4.5
	k7	0	25	6	2	1	*34*	0.0	20.5	30.0	4.0	2.3
	SUM	*19*	*122*	*20*	*50*	*44*	*255*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
6	k1	6	10	1	3	14	*34*	31.6	8.2	5.0	6.0	31.8
	k2	6	12	2	8	8	*36*	31.6	9.8	10.0	16.0	18.2
	k3	4	26	0	3	12	*45*	21.1	21.3	0.0	6.0	27.3
	k4	2	42	10	30	7	*91*	10.5	34.4	50.0	60.0	15.9
	k5	1	7	1	4	2	*15*	5.3	5.7	5.0	8.0	4.5
	k6	0	25	6	2	1	*34*	0.0	20.5	30.0	4.0	2.3
	SUM	*19*	*122*	*20*	*50*	*44*	*255*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
5	k1	6	10	1	3	14	*34*	31.6	8.2	5.0	6.0	31.8
	k2	10	38	2	11	20	*81*	52.6	31.1	10.0	22.0	45.5
	k3	2	42	10	30	7	*91*	10.5	34.4	50.0	60.0	15.9
	k4	1	7	1	4	2	*15*	5.3	5.7	5.0	8.0	4.5
	k5	0	25	6	2	1	*34*	0.0	20.5	30.0	4.0	2.3
	SUM	*19*	*122*	*20*	*50*	*44*	*255*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
4	k1	16	48	3	14	34	*115*	84.2	39.3	15.0	28.0	77.3
	k2	2	42	10	30	7	*91*	10.5	34.4	50.0	60.0	15.9
	k3	1	7	1	4	2	*15*	5.3	5.7	5.0	8.0	4.5
	k4	0	25	6	2	1	*34*	0.0	20.5	30.0	4.0	2.3
	SUM	*19*	*122*	*20*	*50*	*44*	*255*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
3	k1	16	48	3	14	34	*115*	84.2	39.3	15.0	28.0	77.3
	k2	2	42	10	30	7	*91*	10.5	34.4	50.0	60.0	15.9
	k3	1	32	7	6	3	*49*	5.3	26.2	35.0	12.0	6.8
	SUM	*19*	*122*	*20*	*50*	*44*	*255*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
2	k1	16	48	3	14	34	*115*	84.2	39.3	15.0	28.0	77.3
	k2	3	74	17	36	10	*140*	15.8	60.7	85.0	72.0	22.7
	SUM	*19*	*122*	*20*	*50*	*44*	*255*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

Table 65. Number (left) and proportion (right) of cores from the various focus areas as placed in the different clusters in the dendrogram. Colours are used to highlight the proportions of finds in the different clusters. The colours represent percentages: orange: 0%, light yellow: 1-9%, light green: 10-19%, medium light green: 20-29%, medium green: 30-49%, medium dark green: 50-69%, dark green: more than 70%.

(12%). Finally, the cores from F4 are distributed in the same way as previously, with most cores in k1 (77.3%), followed by k2 (15.9%) and only very small amounts in k3.

Finally, as the data is clustered in only **2 clusters**, we find most cores from F1 in cluster 1 (84.2%). For F2a, a slight majority of cores is found in k2 (60.7%). Furthermore, the cores from F2a and F3 are mainly found in k2, amounting to 85% of the cores from F2b and 72% of cores from F3. The cores from F4 instead mainly group in k1 (77.3%), like the cores from F1.

Based on these results, it appears that the core attributes relating to platform morphology (PMORPH), platform preparation (PPCD) and core side preparation (KS_comb) cluster differently in different focus areas. The investigation of the dendrogram indicates that it can be cut on a level that provides us with 2, or possibly 3 clusters. When we cluster the data in 2 clusters, k1 contains most of the cores from focus area 1 and 4, while k2 mainly contains cores from focus areas 2a, 2b and 3. Another important thing to note, however, is the presence of cores from all focus areas in both clusters. Thus, there is overlap in the technology relating to these cores across the whole research area, although certain combinations of traits are more common in different areas. This is especially clear in focus areas 2a, where we find the cores almost equally divided between the technological clusters. In this focus area, the making of this type of core was clearly varied. On the contrary, there is less variation within the assemblages from focus areas 1 and 2b, both of which have over 80% of the cores falling within one cluster.

6.1.3.5 The cores: Correspondence analysis

Although the cluster analysis could show which attributes relate to which focus areas, the results did not specify which attribute variations were common in each focus area. Therefore, a correspondence analysis was done in order to investigate the previously indicated relationships in more detail. Furthermore, in preparation for the correspondence analysis, the data was separated by site, rather than focus area, for a further detailed look on the technological variations. The attributes relating to platform preparation (PPCD), platform morphology (PMORPH) and core side preparation (KS_comb) were used in the analysis.

Platform preparation dorsal (PPCD)

The acquired eigenvalues show that most information can already be found in the first two dimensions (76.3%), which is illustrated in figure 146. There is thus little need to explore any further dimensions of the correspondence plot. A more detailed view on which rows contribute to the different dimensions show that the assemblages from Lithuania, Tågerup and Stanovoye 4 “determine” the first dimension, while assemblages Dreggers 3, Halden-lok 3, Tågerup and Ljungaviken “determine” the second dimension.

On the x-axis, we see dimension 1, representing 54.2% of the information in the plot. On the right side of the plot, the two attributes PPCD 1 (abrasion) and PPCD 3 (trimming and abrasion) are located. On the left, attributes PPCD 4 (trimming/abrasion on PF) and PPCD 5 (regular trimming/abrasion and trimming/abrasion on PF) are instead located. In between the two are the attributes PPCD 0 (no preparation) and PPCD 2 (trimming).

Dimension 2, on the y-axis, represents 22.1% of the information. In the upper part of the plot (positive values), the attributes PPCD 0 (no preparation)

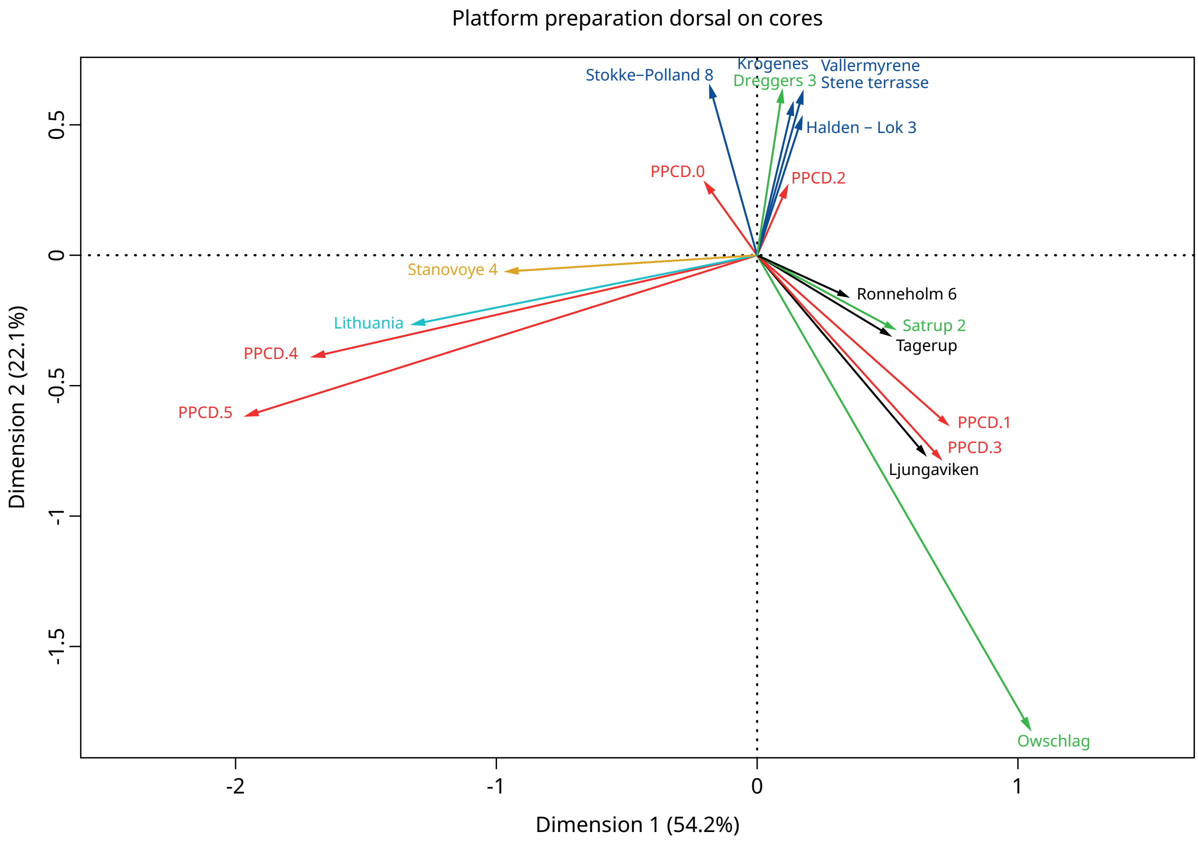


Figure 146. Correspondence analysis plot showing the correspondence (association) of attribute variations of platform preparation dorsal (PPDC, in red) with the sites in the research area in various colours (F1 in mustard, F2a in black, F2b in green, F3 in blue and F4 in teal). Dimensions 1 and 2 are displayed. The length of the arrows, along with the angles between the arrows, indicates the strength of the associations, with longer arrows and smaller angles showing stronger associations. PPCD.0 is a lack of platform preparation, PPCD.1 is abrasion. Attribute morphologies include: PPCD.2 = trimming, PPCD.3 = trimming and abrasion, PPCD.4 = trimming/abrasion on top of the platform near the front, and PPCD.5 = a combination of PPCD.3 and PPCD.4.

and PPCD 2 (trimming) are positioned. On the lower end of the plot, we find the rest of the attributes.

The attributes PPCD 1 and PPCD 3 are located very close together and are situated in the lower right side of the plot. In close proximity to them, we find the sites Rönneholm 6, Satrup 2, Tågerup, Ljungaviken and Owschlag. The small angles between the sites and attributes indicate that there is association between them. Strong association can be assumed for the sites Owschlag and Ljungaviken, which both have longer arrows. The sites Rönneholm, Satrup and Tågerup have weaker associations, as seen by the shorter arrows. Therefore, it can be assumed that relatively high amounts of cores from these sites have abrasion and a combination of abrasion and trimming, with the highest relative amounts from the sites Owschlag and Ljungaviken.

The attributes PPCD 4 and PPCD 5 are located close together on the lower left part of the plot. The sites Stanovoye 4 and the Lithuanian assemblages are situated nearby. Low angles and long arrows indicate rather strong associations between these attributes and the sites. Thus, it can be assumed that trimming and abrasion on PF as well as a combination of regular trimming/abrasion and trimming/abrasion on PF were found on comparatively high amounts of cores from these sites.

The attributes PPCD 0 and PPCD 2 are both located in the upper part of the plot. They are situated rather close together, but not as close as the already mentioned attribute groups. The site Stokke-Polland is located closer to PPCD 0 than the other sites. However, the relatively small angle and short/medium long blue arrow and the short red arrow indicate a moderate association between the two. Thus, the proportion of cores that have an absence of dorsal platform preparation is probably slightly higher in the assemblage from Stokke-Polland compared to other sites. The sites Krøgenes, Stene terrasse, Lokalitet 3, Halden excavations (Halden-Lok 3) and Dreggers are located near the attribute PPCD 2, which represents an association to trimming, although this attribute and the nearby sites also have small angles but short arrows, indicating weak associations.

Interestingly, there seem to be clear regional profiles related to the different manners of dorsal platform preparation. The attributes PPCD 1 and PPCD 3, abrasion and a combination of trimming and abrasion, seem more common at sites from focus areas 2a and 2b. The attributes PPCD 4 and PPCD 5 are more common on cores from Stanovoye and Lithuania. Lastly, attributes PPCD 0 and PPCD 2 are most common on finds from focus areas 2b and 3.

Platform morphology (PMORPH)

The acquired eigenvalues show that most information can already be found in the first dimension (84.6%). The remaining information is then found in dimension 2 (15.4%). A more detailed view on which rows contribute to the different dimensions shows that the assemblages from Lithuania, Dreggers, Stanovoye 4 and Rönneholm 6 “determine” the first dimension, while assemblages Ljungaviken and Rönneholm 6 together “determine” the second dimension.

On the x-axis, we see dimension 1, representing 84.6% of the information in the plot (Fig. 147). On the right side of the plot, the attribute PMORPH 1 (smooth PF) is positioned. On the left, we instead find the attribute PMORPH 2 (faceted PF). PMOPRH 3 (partial faceting) is located between the two. This axis seems to reflect the amount of faceting, with no faceting on the right (positive) side of the plot, partial faceting to its left, followed by complete faceting on the leftmost side.

Dimension 2, on the y-axis, represents 15.4% of the information. On the bottom part of the plot, both attributes PMORPH 1 (smooth PF) and PMORPH 2 (facetted PF) are located. In the upper part, PMORPH 3 (partial faceting) is situated.

The attribute PMORPH 1 is located on the right (positive) side of the plot. Situated nearby are the sites Dreggers, Satrup 2, Owschlag, Stene terrasse, Halden-Lok 3 and Rönneholm 6. The angles between the sites and the attribute indicate some association and with the sites Dreggers, Owschlag, Rönneholm and Stene terrasse the longer arrows indicate slightly stronger associations than the remaining sites, although all these sites have higher relative amounts of cores with smooth platforms than the remaining cores in the study.

The attribute PMORPH 2 is situated on the left (negative) side of the plot. The sites Stanovoye and Lithuania are found very close to the attribute and the associations between them seem strong, based on the small angles and long arrows. The Tågerup assemblage is also situated in the general direction of this attribute, but the extremely short arrow indicates that this association is weak. The Tågerup assemblage seems to be the site closest to the origin among all of the sites.

The attribute PMORPH 3 is found at the very top part of the plot. Nearby, we find the sites Ljungaviken, Krøgenes and Vallermyrene. These sites are all associated with the attribute, but especially Ljungaviken indicates very strong associations, followed by Vallermyrene and Krøgenes. The site Stokke-Polland 8 can be found almost exactly between PMORPH 2 and PMORPH 3, indicating that its assemblage contains relatively high amounts of both faceted and partially faceted platforms.

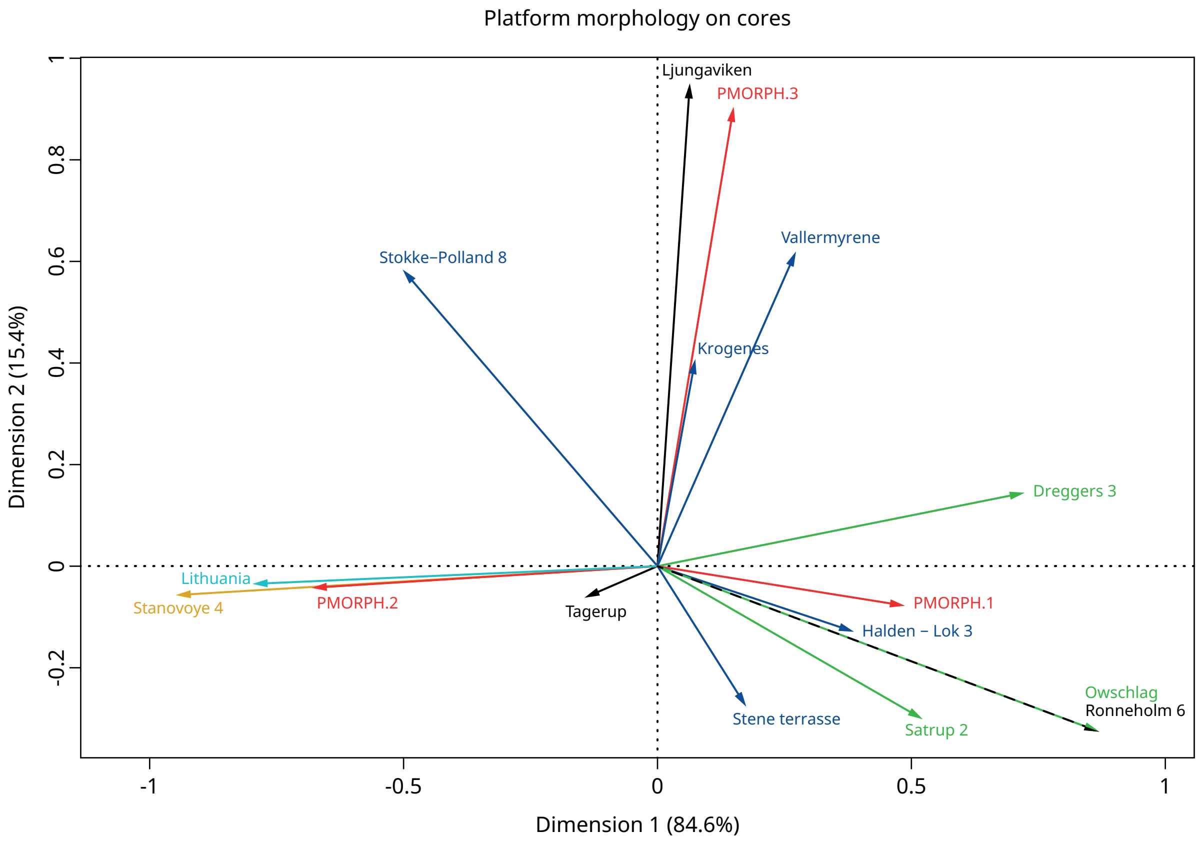


Figure 147. Correspondence analysis plot showing the correspondence (association) of attribute variations of platform morphology (PMORPH, in red) with the sites in the research area in various colours (F1 in mustard, F2a in black, F2b in green, F3 in blue and F4 in teal). Dimensions 1 and 2 are displayed. The length of the arrows, along with the angles between the arrows, indicates the strength of the associations, with longer arrows and smaller angles showing stronger associations. Attribute morphologies include: PMORPH.1 = smooth platforms, PMORPH.2 = faceted platforms, and PMORPH.3 = partially faceted platforms.

Focus areas 2a, 2b and 3 are mainly associated with smooth platforms (PMORPH 1), while focus areas 1 and 4 are associated with faceted platforms. Partially faceted platforms are more strongly associated with focus areas 2a and 3.

Cores side preparation (KS_comb)

The eigenvalues show that a lot of information can already be found in the first dimension (47.1%). Along with dimensions 2 (16.5%) and 3 (15.3%), a retention of 78.9% is provided. These three dimensions will be explored below. A more detailed view on which rows contribute to the different dimensions shows that the assemblages from Lithuania, Dreggers, Stanovoye 4, Ljungaviken and Halden-Lok 3 "determine" the first dimension, while assemblages Rönneholm 6 and Satrup 2 together "determine" the second dimension.

When the first and second dimensions are displayed (Fig. 148), a total of 63.5% of the information is viewed. Focusing first on the x-axis, some patterns emerge. On the right hand side of the plot (positive values), we find KS_comb attributes 33, 31, 13, 23 and 32. On the left hand side (negative values), we instead find the KS_comb attributes 12, 11, 21 and 22. On the y-axis, we find the KS_comb attributes 13, 12, 32, 31, 21, 23, 11 on the upper part of the plot (positive values), and we find 33 and 22 on the bottom part (negative values). It is not clear what this axis represents.

When the first and third dimensions are displayed, a total of 62.4% of the information is available (Fig. 149). The x-axis has already been described above. The new y-axis, representing dimension 3, now shows KS_comb attributes 31, 12, 33 and 21 as positive values and attributes 23, 11, 32, 22 and 13 as negative values.

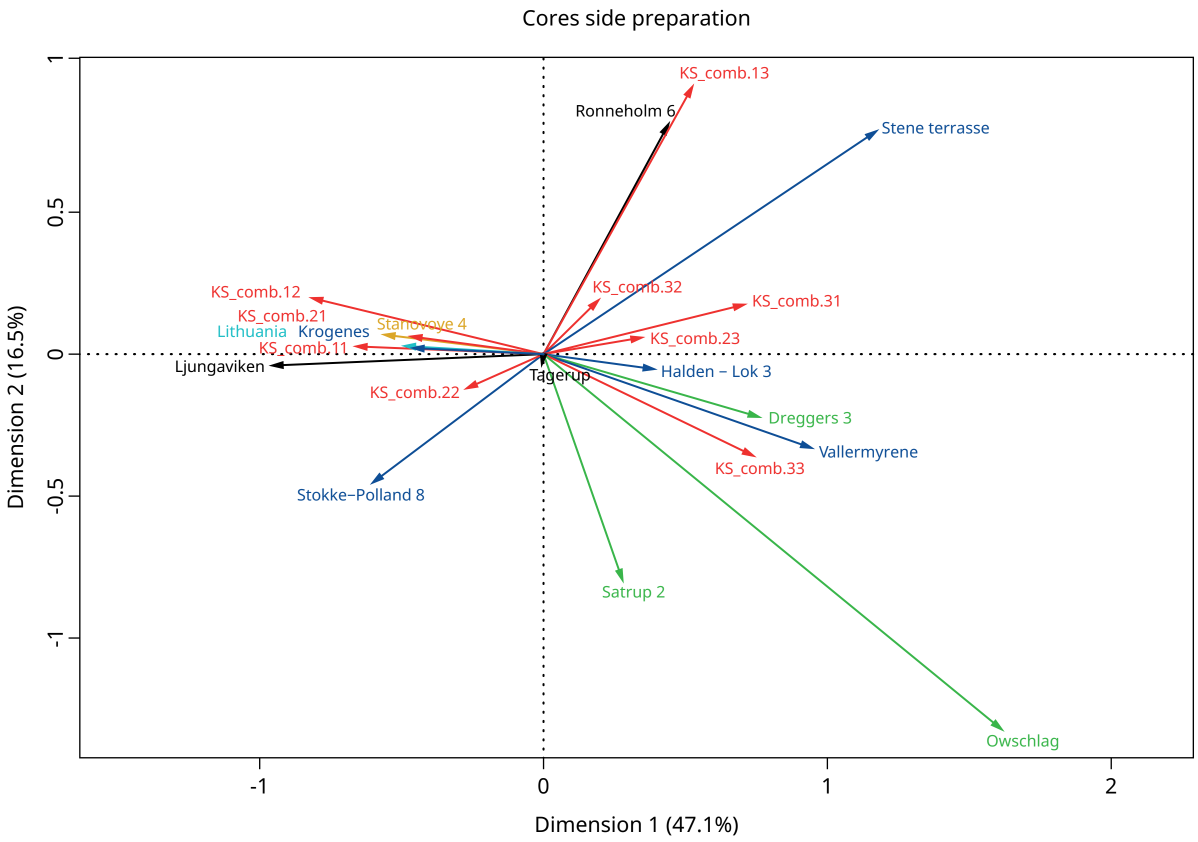


Figure 148. Correspondence analysis plot showing the correspondence (association) of attribute variations of core sides-combined (KS_comb, in red) with the sites in the research area in various colours (F1 in mustard, F2a in black, F2b in green, F3 in blue and F4 in teal). Dimensions 1 and 2 are displayed. The length of the arrows, along with the angles between the arrows, indicates the strength of the associations, with longer arrows and smaller angles showing stronger associations. For an explanation of KS_comb numbers, see Table 54.

Finally, when the second and third dimensions are displayed, a total of 31.8% of the information is viewed (Fig. 150). Along the x-axis, we find dimension 2 with the positive value-attributes 13, 12, 32, 31, 23, 21, 11, and among the negative values, the attributes 33 and 22. On the y-axis, the attributes with positive values are represented by 31, 12, 33, 21 and the attributes on the negative side are represented by 23, 11, 32, 22 and 13.

In the following part, a focus will be placed on describing the plots which show the most information, dimensions 1 and 2 as well as 1 and 3. On the positive side of the plot, we find the sites Owschlag, Satrup, Dreggers, Vallermyrene, Halden-Lok 3, Stene terrasse and Rönneholm 6. Not all these sites, however, relate to all attributes. Some closer associations can be seen in the form of smaller angles and longer arrows between KS_comb 13 and Rönneholm 6 (strong association) as well as Stene terrasse (medium strong association). Additionally, the attribute KS_comb 33 seems to be more strongly associated with the sites Vallermyrene and Dreggers, and less associated with Owschlag and Satrup 2. The remaining attributes generally show either large angles to the sites or have very short arrows, which indicate weak associations.

On the negative side of the plot, we find Ljungaviken, Stokke-Polland 8, Lithuania and Stanovoye 4. Most of the attributes on this side are located near the plot origin, which shows that their associations to the sites are generally weak. Nonetheless, some association between the attributes and sites exists. Slightly stronger associations exist between attributes KS_comb 12 and KS_comb 21 (both of which involve a cortex and flake negatives/one large negative) and sites Stanovoye 4 and Lithuania, as well as Ljungaviken. Ljungaviken also seems somewhat associated

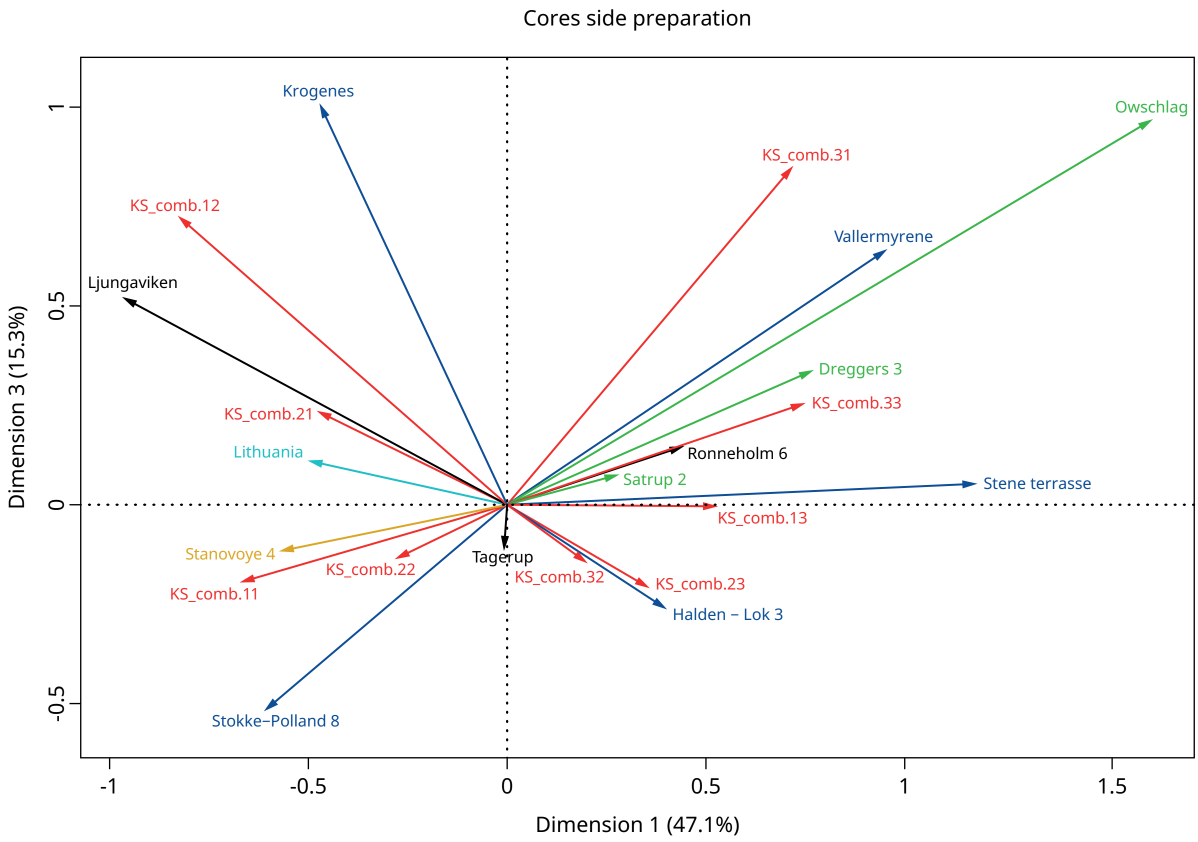


Figure 149. Correspondence analysis plot showing the correspondence (association) of attribute variations of core sides-combined (KS_comb, in red) with the sites in the research area in various colours (F1 in mustard, F2a in black, F2b in green, F3 in blue and F4 in teal). Dimensions 1 and 3 are displayed. The length of the arrows, along with the angles between the arrows, indicates the strength of the associations, with longer arrows and smaller angles showing stronger associations. For an explanation of KS_comb numbers, see Table 54.

with KS_comb 11. Stokke-Polland 8 seems most associated (although generally weakly) with KS_comb 22.

When the first and third dimensions are viewed, some different patterns become clear. Now, KS_comb 12 seems more strongly associated with Krøgenes and Ljungaviken. KS_comb 11 seems more strongly associated with Stanovoye 4 and somewhat associated with Stokke-Polland 8. The attribute KS_comb 31 is somewhat associated with sites Vallermyrene and Owschlag. KS_comb 33 is associated with Dreggers and less so with Rönneholm and Satrup. KS_comb 13 is associated with Stene terrasse. Lastly, KS_comb 32 and 23 are related with the site Halden-Lok 3.

To summarise, there seem to be some associations between attributes with the same combination of preparation, as well as some regional patterns. These include, for instance, Stanovoye 4, Lithuania and Ljungaviken, which have higher relative amounts of cores with flake negatives and/or one large flake negative on their core sides (KS), followed by Krøgenes and Stokke-Polland.

6.1.3.6 The blades: Pearson's Chi-square test

The Pearson's chi-square test (Table 66) was performed on two variables: focus area (2a, 2b and 3) and the different attributes. The results provide small p-values for most attributes, indicating that the attribute data is associated with the different focus areas, and is thus not random.

Two attributes, relating to blade termination 2 (BT2) and blade regularity (REG) have p-values that are higher or equal to 0.05, and are thus more likely to lack an association with the different focus areas. The patterns relating to these attributes might therefore be a result of some randomness.

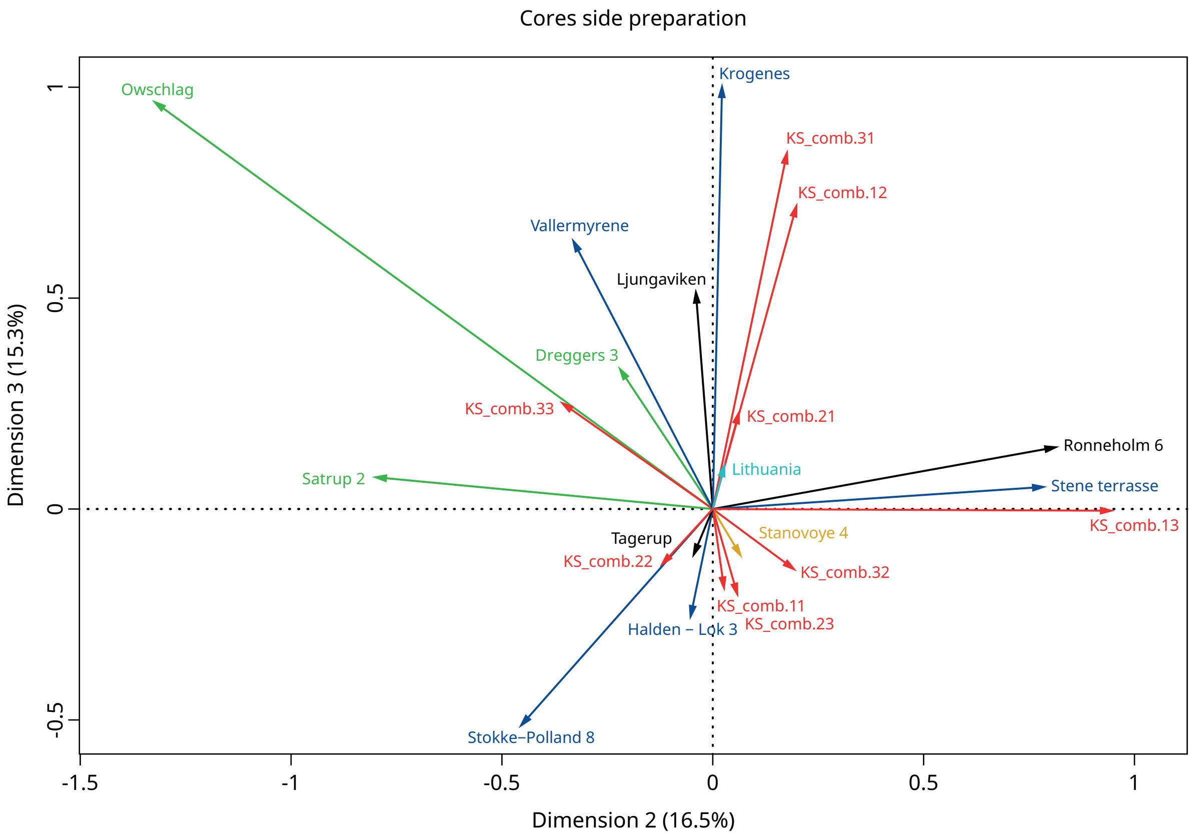


Figure 150. Correspondence analysis plot showing the correspondence (association) of attribute variations of core sides-combined (KS_comb, in red) with the sites in the research area in various colours (F1 in mustard, F2a in black, F2b in green, F3 in blue and F4 in teal). Dimensions 2 and 3 are displayed. The length of the arrows, along with the angles between the arrows, indicates the strength of the associations, with longer arrows and smaller angles showing stronger associations. For an explanation of KS_comb numbers, see Table 54.

Attribute	X-squared	df	p-value	Accept/reject null
DBF	63.326	16	< 0,001	reject
BT1	88.113	8	< 0,001	reject
BT2	5.9735	2	0,050	accept
CURV	44.994	6	< 0,001	reject
TWIST	18.314	2	< 0,001	reject
WN	146.06	4	< 0,001	reject
REG	2.0196	4	0,732	accept
SFPD	284.77	6	< 0,001	reject
SFPE	199.79	10	< 0,001	reject
KE	38.699	6	< 0,001	reject
SL	24.389	6	< 0,001	reject

Table 66. Results of the Pearson’s chi-square test for focus areas and attributes. P-values are rounded to three decimal places.

Certain attributes were shown to be more strongly associated with the research areas than others, as exhibited by extremely low p-values (≤ 0.0005). These include dorsal blade face (DBF), blade termination 1 (BT1), blade curvature (CURV), blade twist (TWIST), Wallner lines (WN), platform preparation dorsal (SFPD), platform preservation (SFPE), conus formation (KE) and lip (SL). These results indicate that these attributes have very strong associations to the focus areas, making them interesting for further investigation. Exactly how the different attributes and the attribute morphologies are associated with the various focus areas will become clearer by comparing expected and observed values.

6.1.3.7 The blades: Expected and observed values

The small p-value (< 0.001), listed for the dorsal blade face (DBF) above, indicated a strong association between the attribute and the focus areas. When comparing expected and observed (Table 67) values, it becomes clear that there is a larger number of observed blades with 2 dorsal blade faces and a smaller number of 3 dorsal blade faces than what was expected in focus area 2b. The same is true for focus area 2a, but the absolute difference is smaller. The opposite relationship is seen for focus area 3, where there were fewer blades with 2 dorsal faces and more blades with 3 dorsal faces than expected. Some smaller differences between expected and observed values also relate to the blades with some form of remaining dorsal cortex (variations 1, 2 or 3). In focus area 2b, there are slightly more blades than expected with a remaining cortex on one dorsal face (variations 2 and 3), while in focus areas 2a and 3, there are fewer blades than expected with remaining dorsal cortex (variations 2 and 3).

Blade termination 1 (BT1) is shown to have an association (p-value < 0.001) with the different focus areas, while p-values relating to blade termination 2 (BT2) indicate no or low association (p-value = 0.050). This is also somewhat reflected in the expected and observed values (Table 68 and Table 69). For BT1, there are large absolute differences between expected and observed values, as seen by the strong green and yellow colours. The datasets from focus areas 2a and 2b contain fewer broken blades than expected and larger quantities of blades with ideal or feathered distal ends than expected. Focus area 3 shows the opposite. Here, there are more broken distal ends than expected and fewer blades with ideal or feathered terminations.

A comparison between the expected and observed values relating to blade termination 2 (BT2) does show some differences, although they are only slight. In focus areas 2a and 3, there are some more blades with pointed distal ends and fewer blades with straight ends than expected. On the contrary, the assemblage from focus area 2b contains fewer blades than expected showing pointed distal ends and more blades than expected with straight terminations.

The p-values relating to blade curvature (CURV) indicated a strong association to the different focus areas (< 0.05), which is also seen in the expected and observed values (Table 70). Large absolute differences are seen in focus areas 2b and 3, and smaller differences are found for focus area 2a. In focus area 2b, there are fewer blades with distal curvature and more blades with even curvature than expected. Additionally, there are fewer blades than expected that are straight. In focus area 3, a lot more blades than expected are straight while fewer blades than expected have an even curvature. Distal curvature is also observed in higher amounts than expected. In focus area 2a, there is a lower number of observed

		Expected									Observed								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
DBF	**2a**	1	13	9	268	286	44	0	6	1	1	13	5	279	278	46	0	5	1
	2b	0	7	5	138	147	22	0	3	0	0	13	12	156	112	22	1	6	1
	3	1	8	5	165	175	27	0	3	1	1	2	2	136	218	25	0	1	0

Table 67. Expected and observed values for the DBF attribute variations (1-9). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

		Expected					Observed				
		0	**1**	**2**	**3**	**4**	**0**	**1**	**2**	**3**	**4**
BT1	**2a**	439	166	80	4	9	401	178	105	3	12
	2b	208	79	38	2	4	179	91	50	5	6
	3	242	91	44	2	5	309	67	7	1	1

Table 68. Expected and observed values for the BT1 attribute variations (0-4). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

		Expected		Observed	
		1	**2**	**1**	**2**
BT2	**2a**	133	143	140	136
	2b	65	69	53	81
	3	36	39	41	34

Table 69. Expected and observed values for the BT2 attribute variations (1-2). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

		Expected				Observed			
		1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
CURV	**2a**	212	80	352	9	200	89	356	8
	2b	101	38	167	4	90	16	196	8
	3	85	32	141	4	108	45	108	1

Table 70. Expected and observed values for the CURV attribute variations (1-4). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

		Expected		Observed	
		0	**1**	**0**	**1**
TWIST	**2a**	426	256	463	219
	2b	204	122	179	147
	3	196	117	184	129

Table 71. Expected and observed values for the TWIST attribute variations (0-1). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

		Expected			Observed		
		0	**1**	**2**	**0**	**1**	**2**
WN	**2a**	187	463	87	130	548	59
	2b	86	214	40	69	203	69
	3	97	240	45	171	166	45

Table 72. Expected and observed values for the WN attribute variations (0-2). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

		Expected			Observed		
		1	**2**	**3**	**1**	**2**	**3**
REG	**2a**	122	550	56	119	554	55
	2b	56	251	25	52	251	29
	3	63	282	29	70	278	26

Table 73. Expected and observed values for the REG attribute variations (1-3). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

		Expected				Observed			
		0	**1**	**2**	**3**	**0**	**1**	**2**	**3**
SFPD	**2a**	62	147	305	225	42	216	221	260
	2b	25	61	126	93	24	39	100	142
	3	32	76	158	117	53	29	267	33

Table 74. Expected and observed values for the SFPD attribute variations (0-3). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

blades that are straight than expected and there are more blades that have distal or even curvature than expected.

Blade twist (TWIST) is observed to have an association with the focus areas (p-value < 0.001). A comparison of expected and observed values also shows rather large absolute differences between the two (Table 71). In focus area 2a, there is a larger number of blades without twist and a smaller number of blades with twist than expected. The opposite trend is observable for focus areas 2b and 3, where more blades than expected display twist and fewer blades lack twist.

Based on very low p-values (< 0.001), related to Wallner lines (WN), a strong association between focus areas and the attribute is observed, which is further supported by large differences between the expected and observed values (Table 72). In focus area 2a, there are much larger numbers of blades that have fine, proximally placed, Wallner lines. There are also much smaller numbers of blades without Wallner lines as well as with pronounced Wallner lines than expected. In focus area 2b, there are much larger numbers of blades with pronounced Wallner lines than expected, as well as fewer blades displaying no Wallner lines or fine lines. In focus area 3, the blades lack any Wallner lines more than expected. Instead, there are fewer blades than expected that have fine Wallner lines.

The p-values relating to blade regularity (REG) indicate that there is no association between the focus areas and this attribute (p-value = 0.732). This is also clear from the very small differences in number of finds seen in the comparison between expected and observed values (Table 73). In focus area 2a, there are slightly fewer blades that are irregular and some more blades that are regular than expected. In focus area 2b, there are also fewer irregular blades than expected. Instead, there are more blades that are extremely regular than expected. In contrast, the blades from focus area 3 contain some more irregular blades than expected and instead somewhat smaller numbers of blades that are regular and extremely regular.

Platform preparation dorsal (SFPD) is observed to have a strong association with the focus areas (< 0.001), as is also evident by comparing the expected and observed values (Table 74). In focus area 2a, there are many more blades that have abrasion or a combination of trimming and abrasion than expected. Instead, there are fewer blades that lack platform preparation or that have trimming. In focus area 2b, there are also many more blades that show a combination of trimming and abrasion and fewer blades that are prepared using abrasion or trimming on their own. In focus area 3, there are instead more blades that lack platform preparation and that have trimming than expected. Instead, fewer blades are prepared using only abrasion or a combination of abrasion and trimming.

Platform preservation (SFPE) is observed to have a strong association with the focus areas (< 0.001), as is further indicated by the expected and observed values (Table 75). In focus area 2a, there is a greater number of blades with smooth platforms and a lower number of blades with crushed or faceted platforms (variations 5 and 7) than expected. In focus area 2b, there is a higher number of blades with crushed platforms and lower numbers of blades with smooth platforms than expected. In focus area 3, there are larger numbers of blades that have faceted platforms and a lower number of blades with smooth platforms than expected.

The p-values relating to conus formation (KE) indicate a strong association to the focus areas (< 0.001). This is also supported by the expected and observed values (Table 76). In focus area 2b, there is a much greater number of blades with existing conus formations than what the expected numbers suggest. There are also significantly fewer blades that lack conus formation than expected. The opposite is true for focus area 3, where a larger number of blades than expected lack any form of conus formation and a smaller number of blades than expected display existing conus formation. For focus area 2a, the absolute differences are smaller, however, there are some more blades that display conus formation only visible on the platform and fewer blades that have full existing conus formation than expected.

The p-values relating to lip formation (SL) indicate that there is an association between this attribute and the focus areas (< 0.001). This is supported by the comparison between expected and observed values (Table 77).

In focus area 2a, there are more blades without a lip than expected. There are also much lower numbers of blades that display a diffuse lip than expected,

		Expected						Observed					
		0	**1**	**2**	**3**	**5**	**7**	**0**	**1**	**2**	**3**	**5**	**7**
SFPE	**2a**	5	3	615	30	66	14	0	4	692	12	22	3
	2b	2	1	250	12	27	6	6	1	229	32	26	4
	3	3	1	312	15	34	7	4	0	256	14	79	19

Table 75. Expected and observed values for the SFPE attribute variations (0-3, 5, 7). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

		Expected				Observed			
		0	**1**	**2**	**3**	**0**	**1**	**2**	**3**
KE	**2a**	601	106	14	2	599	103	19	1
	2b	218	38	5	1	193	60	7	2
	3	303	53	7	1	330	34	0	0

Table 76. Expected and observed values for the KE attribute variations (0-3). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

		Expected				Observed			
		0	**1**	**2**	**3**	**0**	**1**	**2**	**3**
SL	**2a**	256	455	14	6	271	439	10	12
	2b	96	170	5	2	84	178	12	0
	3	130	231	7	3	127	239	5	0

Table 77. Expected and observed values for the SL attribute variations (0-3). Any differences between expected and observed values are highlighted with yellow colour (for lower observed frequencies than expected) and green colour (for higher observed frequencies than expected). A light yellow/green colour represents differences from 3 to 9 blades, a slightly stronger yellow/green represents differences between 10-19 blades and a very strong yellow/green colour represents differences with 20 blades or more.

and some less than expected blades with pronounced lips. In focus area 2b, the opposite trend is observable, with more blades that have diffuse or pronounced lips and fewer blades that lack lip formation than expected. Similarly, there are also more blades than expected with diffuse lips in focus area 3, as well as slightly fewer blades than expected without lip formation.

6.1.3.8 The blades: Shapiro-Wilk and Wilcoxon rank sum test (blade size and butt size)

Before comparing the height, width and length of the blades in the different focus areas, the normality of the data was investigated. The normal distribution of the different datasets (L, B, D in each focus area) was checked using a Shapiro-Wilk test, which showed that none of the datasets are normally distributed (Table 78).

Because of the absence of normally distributed data, it was decided to proceed with pairwise comparisons using the Wilcoxon rank sum test (Table 79). The p-values were adjusted using the Bonferroni-method.

The tests show that there are significant differences between the medians of blade length (L) and blade width (B) in the different regional datasets. Although the blade widths of blades from F2a and F2b are more similar than the other measurements included in the test, the p-value is nonetheless lower than 0.05.

When blade thickness (D) is compared using the same method, we find that the blades from F2a and F2b are not significantly different, thus indicating some similarities.

Area	p-value (L)	normal dist.	p-value (B)	normal dist.	p-value (D)	normal dist.
F2a	< 2.2e-16	no	< 2.2e-16	no	< 2.2e-16	no
F2b	4.374e-09	no	5.777e-10	no	2.308e-11	no
F3	2.432e-08	no	0.0001133	no	< 2.2e-16	no

Table 78. Results of the Shapiro-Wilk normality test for blade sizes. The lack of any values above 0.05 indicates that the datasets are not normally distributed.

Blade length (L)		
Focus area	2a	2b
2b	< 0.001	
3	< 0.001	< 0.001

Blade width (B)		
Focus area	2a	2b
2b	< 0.001	-
3	0.037	< 0.001

Blade thickness (D)		
Focus area	2a	2b
2b	< 0.001	-
3	**0.970**	< 0.001

Table 79. Results of the pairwise comparisons using the Wilcoxon rank sum test. The p-values were adjusted using the Bonferroni-method and are rounded to three decimal places. Values above 0.05 are marked in bold.

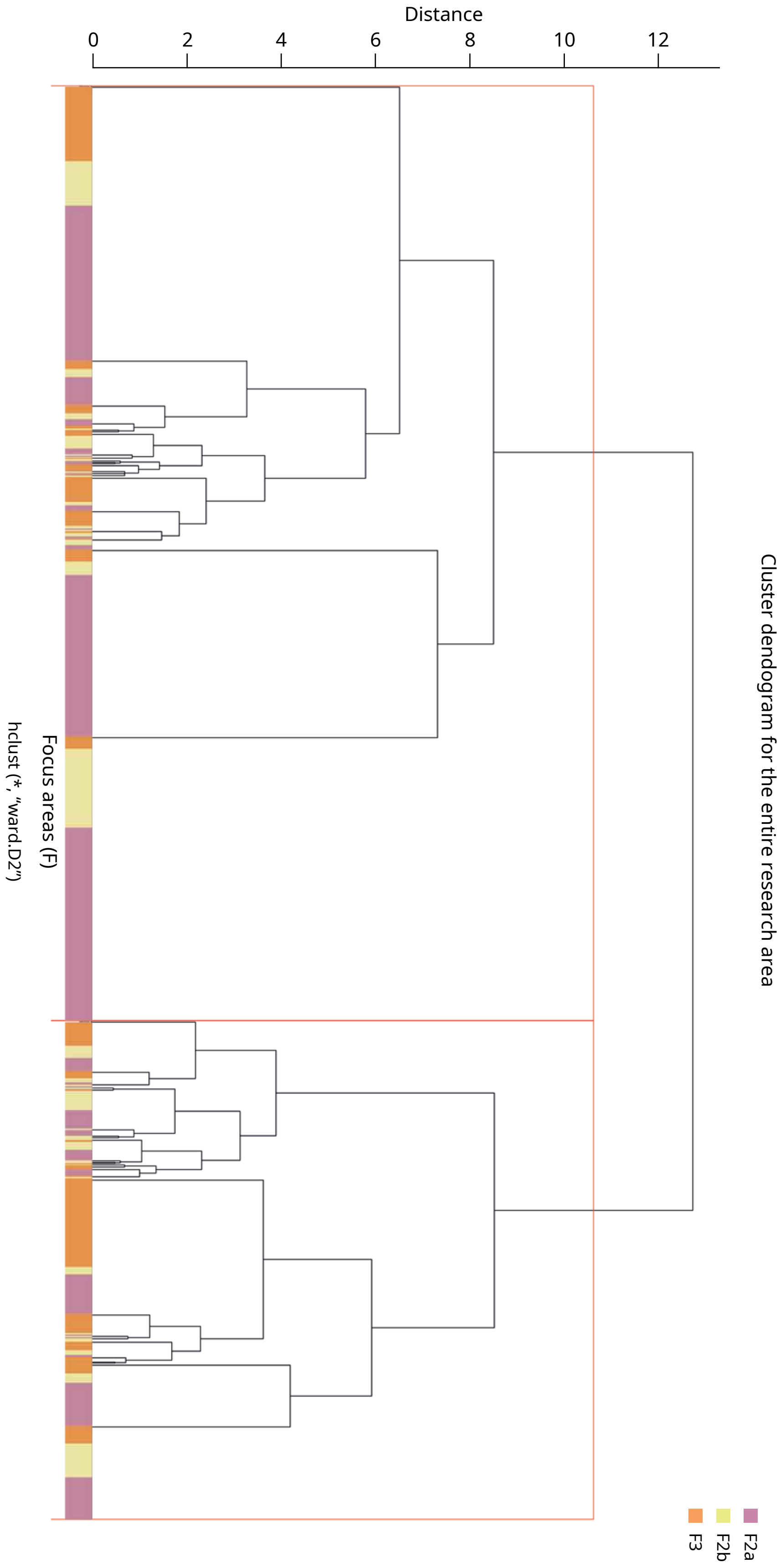


Figure 151. Dendrogram displaying the clustering of sites (coloured according to their focus areas), based on three blade attributes (WN, SFPD and SFPE) recorded from focus areas 2a, 2b and 3. When the dendrogram is cut at two clusters (red squares), most of the sites from focus areas 2a and 2b are found in cluster 1, while most sites from focus area 3 are found in cluster 2. See supplementary materials for a larger version of the figure.

6.1.3.9 The blades: Cluster analysis

After the previously discussed Chi-square tests and the comparison between expected and observed values, three blade attributes stand out as more strongly associated with parts of the research area than others. These are the attributes Wallner lines (WN), dorsal platform preparation (SFPD) and platform preservation (SFPE).

Cluster analysis was chosen to understand if certain combinations of attribute morphologies exist in the datasets from the different focus areas. Therefore, the data was further explored using a hierarchical clustering analysis.

The dendrogram can be seen in figure 151. To approach a relevant number of clusters (k) for interpretation, several different values of k were investigated. Starting at seven clusters (k=7), the number of blades in each cluster, from each focus area, were counted and percentages were calculated. The results can be found in Table 80. By going through the content of each cluster group, some patterns emerge.

When the dendrogram is cut at **7 clusters,** most blades from F2a are divided between cluster (k) 1, 3 and 4, with a slight majority in k4. For F2b, most blades are also found in k4, followed by almost equal parts in clusters 1, 2, 5 and 7. The blades from F3 are mainly found in k6, followed by k1 and k2.

When the dendrogram is cut at **6 clusters**, the blades in the previous clusters 6 and 7 merge into one (here k6). The blades from F2a are still mainly found in k1, k3 and k4, now closely followed by k6. The blades from F2b still show a slight majority in k4, followed by almost equal numbers of blades in k1, k2, k5 and k6. For F3, blades are still mainly found in k6, followed by equal amounts in k1 and k2.

When the dendrogram is cut at **5 clusters**, the blades in the previous clusters 1 and 2 merge into one (here k1). The blades from F2a are now found in k1, k3, k2 and k5 in order of the decreasing number of blades. The blades from F2b are mainly found in k1, followed by k3 and near equal parts in k4 and k5. For F3, most blades divide between k5 and k1, followed by k4.

When the dendrogram is cut at **4 clusters**, the blades in the previous clusters 2 and 3 merge into one (here k2). Most blades from F2a cluster within k2, followed by k1 and k4. Blades from F2b are unique in the sense that they do not cluster so heavily in one or a few of the clusters. Instead, they are found in high amounts in all clusters. The highest amounts are found in k1 and k2 (ca. 30% in each), while k3 and k4 have somewhat lower amounts (ca. 20% in each). Blades from F3 are almost equally distributed between k4 and k1 (ca. 40% in each), followed by much smaller amounts in k3 and k2.

When the dendrogram is cut at **3 clusters**, the blades in the previous clusters 1 and 2 merge into one (here k1). Now, a large majority of blades (75.5%) from F2a fall in k1. This is followed by smaller amounts in k3 and k2. Blades from F2b fall mainly in k1 (62.1%), followed by almost equal amounts in k2 and k3 (ca. 20% in each). The blades from F3 are almost equally distributed in k1 and k3, with a smaller amount in k2.

Finally, as the dendrogram is cut at only **2 clusters**, the blades in the previous clusters 2 and 3 merge into one (here k2). A large majority of blades from F2a fall into k1 (75.5%). For F2b, most blades also fall in k1, but with a slightly more equal division between the two clusters (62.1% in k1 and 37.9% in k2). The blades from F3 divide almost equally between the two clusters, with k1 containing 46.7% and k2 containing 53.3%.

	Absolute numbers					Percentages (%)		
No. of clusters	**Clusters**	**F2a**	**F2b**	**F3**	**SUM**	**F2a**	**F2b**	**F3**
7	k1	148	42	72	*262*	20.5	14.9	20.4
	k2	56	46	69	*171*	7.8	16.3	19.5
	k3	155	12	12	*179*	21.5	4.3	3.4
	k4	185	75	12	*272*	25.7	26.6	3.4
	k5	52	51	43	*146*	7.2	18.1	12.2
	k6	42	16	119	*177*	5.8	5.7	33.7
	k7	83	40	26	*149*	11.5	14.2	7.4
	SUM	*721*	*282*	*353*	*1356*	*100.0*	*100.0*	*100.0*
6	k1	148	42	72	*262*	20.5	14.9	20.4
	k2	56	46	69	*171*	7.8	16.3	19.5
	k3	155	12	12	*179*	21.5	4.3	3.4
	k4	185	75	12	*272*	25.7	26.6	3.4
	k5	52	51	43	*146*	7.2	18.1	12.2
	k6	125	56	145	*326*	17.3	19.9	41.1
	SUM	*721*	*282*	*353*	*1356*	*100.0*	*100.0*	*100.0*
5	k1	204	88	141	*433*	28.3	31.2	39.9
	k2	155	12	12	*179*	21.5	4.3	3.4
	k3	185	75	12	*272*	25.7	26.6	3.4
	k4	52	51	43	*146*	7.2	18.1	12.2
	k5	125	56	145	*326*	17.3	19.9	41.1
	SUM	*721*	*282*	*353*	*1356*	*100.0*	*100.0*	*100.0*
4	k1	204	88	141	*433*	28.3	31.2	39.9
	k2	340	87	24	*451*	47.2	30.9	6.8
	k3	52	51	43	*146*	7.2	18.1	12.2
	k4	125	56	145	*326*	17.3	19.9	41.1
	SUM	*721*	*282*	*353*	*1356*	*100.0*	*100.0*	*100.0*
3	k1	544	175	165	*884*	75.5	62.1	46.7
	k2	52	51	43	*146*	7.2	18.1	12.2
	k3	125	56	145	*326*	17.3	19.9	41.1
	SUM	*721*	*282*	*353*	*1356*	*100.0*	*100.0*	*100.0*
2	k1	544	175	165	*884*	75.5	62.1	46.7
	k2	177	107	188	*472*	24.5	37.9	53.3
	SUM	*721*	*282*	*353*	*1356*	*100.0*	*100.0*	*100.0*

Table 80. Number (left) and proportion (right) of blades from the various focus areas as placed in the different clusters in the dendrogram. Colours are used to highlight the proportions of finds in the different clusters. The colours represent percentages: orange: 0%, light yellow: 1-9%, light green: 10-19%, medium light green: 20-29%, medium green: 30-49%, medium dark green: 50-69%, dark green: more than 70%.

Compared to the clustering of the cores, the blades do not appear to cluster as distinctly in the different focus areas. Blades from the different areas, when cut at 7-4 clusters, are dispersed more evenly across the clusters, without a clear affiliation to one of the clusters. When the dendrogram is cut at three clusters, a rather similar pattern is seen for the different focus areas, with most blades from each focus area falling within cluster 1 (k1), subsequently followed by k2 and k3. This shows that, despite differences in the amounts of blades within each cluster, the blades from the different focus areas are generally similar, *i.e.*, have the same combinations of the attributes Wallner lines (WN), dorsal platform preparation (SFPD) and platform preservation (SFPE), although a slight difference is seen when they are clustered in 2 groups. The blades from F3 group more commonly in k2, while the blades from F2a and F2b are slightly more common in k1. This indicates that the blades in F2a and F2b are more similar to each other than to the blades in F3. Nonetheless, these regional differences are slight and there seems to be plenty of blades from each focus area in the different clusters.

Butt size

Before comparing the butt sizes of the blades in the different focus areas, the normality of the data was investigated. The normal distribution of the different datasets (SFRD and SFRK in each focus area) was checked using a Shapiro-Wilk test, which showed that that none of the datasets are normally distributed (Table 81).

Because of the absence of normally distributed data, it was decided to proceed with pairwise comparisons using the Wilcoxon rank sum test (Table 82). The p-values were adjusted using the Bonferroni-method.

These tests show that there are significant differences between the medians of platform width (SFRD) between the regional datasets. Interestingly, there is not a significant difference related to platform thickness (SFRK) between the blades from F2a and F3. Thus, some similarity can be assumed between the medians relating to these datasets.

Area	p-value (SFRD)	normal dist.	p-value (SFRK)	normal dist.
F2a	< 2.2e-16	no	< 2.2e-16	no
F2b	< 2.2e-16	no	2.321e-10	no
F3	2.26e-08	no	1.833e-11	no

Table 81. Results of the Shapiro-Wilk normality test for butt sizes. Values above 0.05 indicate normally distributed datasets.

Blade platform width (SFRD)		
Focus area	**2a**	**2b**
2b	< 2e-16	-
3	0.00025	< 2e-16
Blade thickness (SFRK)		
Focus area	**2a**	**2b**
2b	4.60E-10	-
3	**0.09**	6.60E-14

Table 82. Results of the pairwise comparisons using the Wilcoxon rank sum test. The p-values were adjusted using the Bonferroni-method. Values above 0.05 are marked in bold.

6.1.3.10 The blades: Correspondence analysis

Wallner lines (WN)

The acquired eigenvalues show that most information can already be found in the first dimension (81.1%). The remaining information is then found in dimension 2 (18.9%). Both dimensions are visualised in figure 152. A more detailed view on which rows contribute to the different dimensions shows that the assemblages from Rönneholm 6 and Vallermyrene 4 “determine” the first dimension, while the assemblage from Satrup 2 “determines” the second dimension.

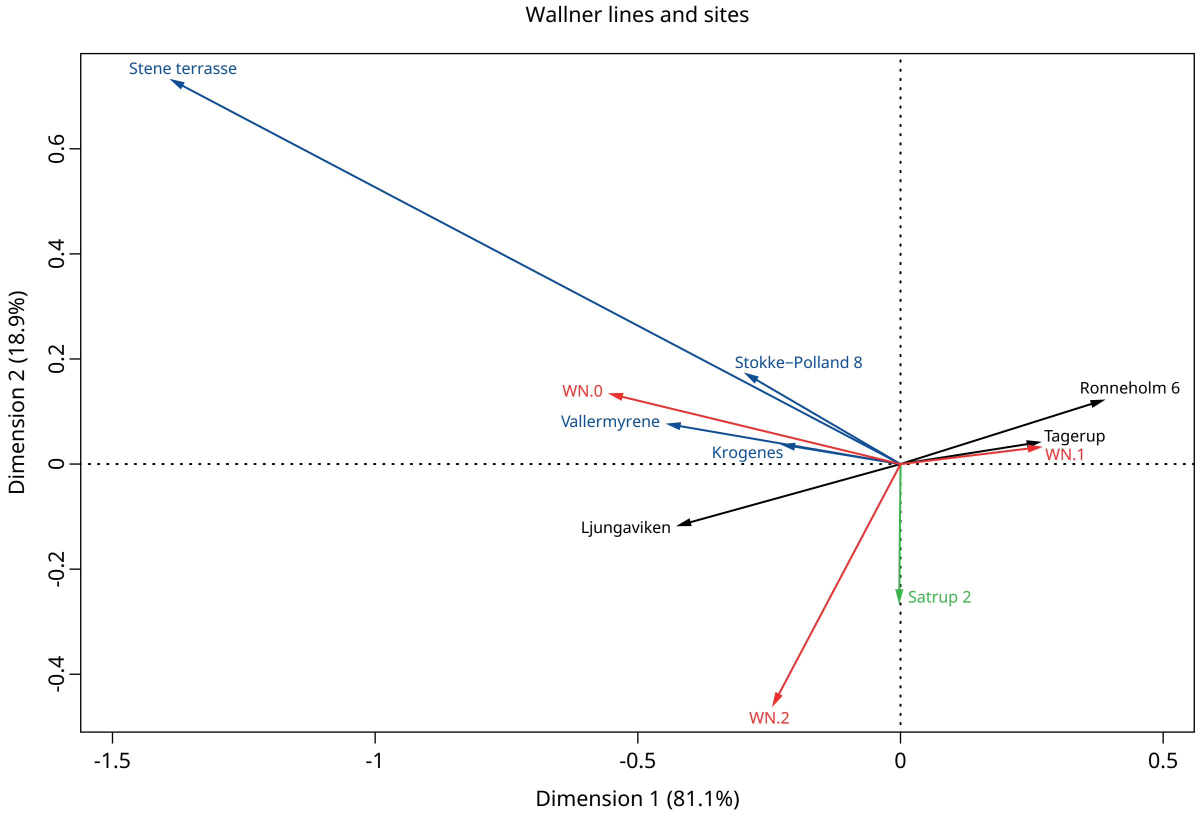
On the x-axis, we see dimension 1. On the right side of the plot, the attribute WN.1 (fine lines) is positioned. On the left, we instead find the attribute WN.0 (no lines). WN.2 (broad lines) is located between the two, but closer to WN.0.

Dimension 2 is found on the y-axis. On the bottom part of the plot, the attribute WN.2 (broad lines) is situated. WN.0 (no lines) is located on the opposite part of the plot. Between the two, we find the attribute WN.1 (fine lines).

The attribute WN.1 is located on the positive side of the plot. The sites Tågerup and Rönneholm are positioned relatively close, indicating a similarity in their regional profiles. Note that both represent focus area 2a. The angles are small but the arrows are short, indicating that there is an association between the sites and the presence of fine Wallner lines although it is not a very strong association.

The attribute WN.2 (broad Wallner lines) is located on the lower left (negative and negative) side of the plot. Positioned nearby are the sites Satrup 2 and Ljungaviken, representing focus areas 2b and 3. The larger angles and rather short arrows, however, indicate weak/medium strong associations.

Figure 152. Correspondence analysis plot showing the correspondence (association) of attribute variations of Wallner lines (WN, in red) with the sites in the research area in various colours (F2a in black, F2b in green and F3 in blue). Dimensions 1 and 2 are displayed. The length of the arrows and the angles between the arrows indicates the strength of the associations, with longer arrows and smaller angles showing stronger associations. Attribute morphologies include: WN.0 = no lines, WN.1 = fine lines, and WN.2 = pronounced lines.



The attribute WN.0 is found in the upper left part of the plot. It is surrounded by sites Stokke-Polland 8, Vallermyrene, Krøgenes, Stene terrasse and Ljungaviken. The assemblage from Stene terrasse is especially strongly associated with the attribute. This indicates that the sites from focus area 3 have higher relative amounts of blades without Wallner lines, compared to other focus areas.

Platform preparation dorsal (SFPD)

The acquired eigenvalues show that most information can already be found in the first dimension (74.7%). Most of the remaining information is then found in dimension 2 (17.5%). Both dimensions are visualised in figure 153. The first two dimensions thus provide a cumulated inertia of 92.1%, which provides a near complete idea about the available information. There is therefore no need to explore further dimensions. A more detailed view on which rows contribute to the different dimensions shows that the assemblages from Vallermyrene 4, Rönneholm 6, Stokke-Polland 8 and Ljungaviken "determine" the first dimension, while the assemblages from Satrup 2, Rönneholm 6 and Tågerup "determine" the second dimension.

On the x-axis, we see dimension 1. On the right side of the plot, the attributes SFPD.0 (no dorsal preparation) and SFPD.2 (trimming) are positioned. On the left, we instead find the attribute SFPD.1 (abrasion) and SFPD.3 (abrasion and trimming). This axis seems to reflect complexity of dorsal preparation.

Dimension 2 is found on the y-axis. On the bottom part of the plot, the attribute SFPD.3 (abrasion and trimming) is located. Further up in the plot, we find

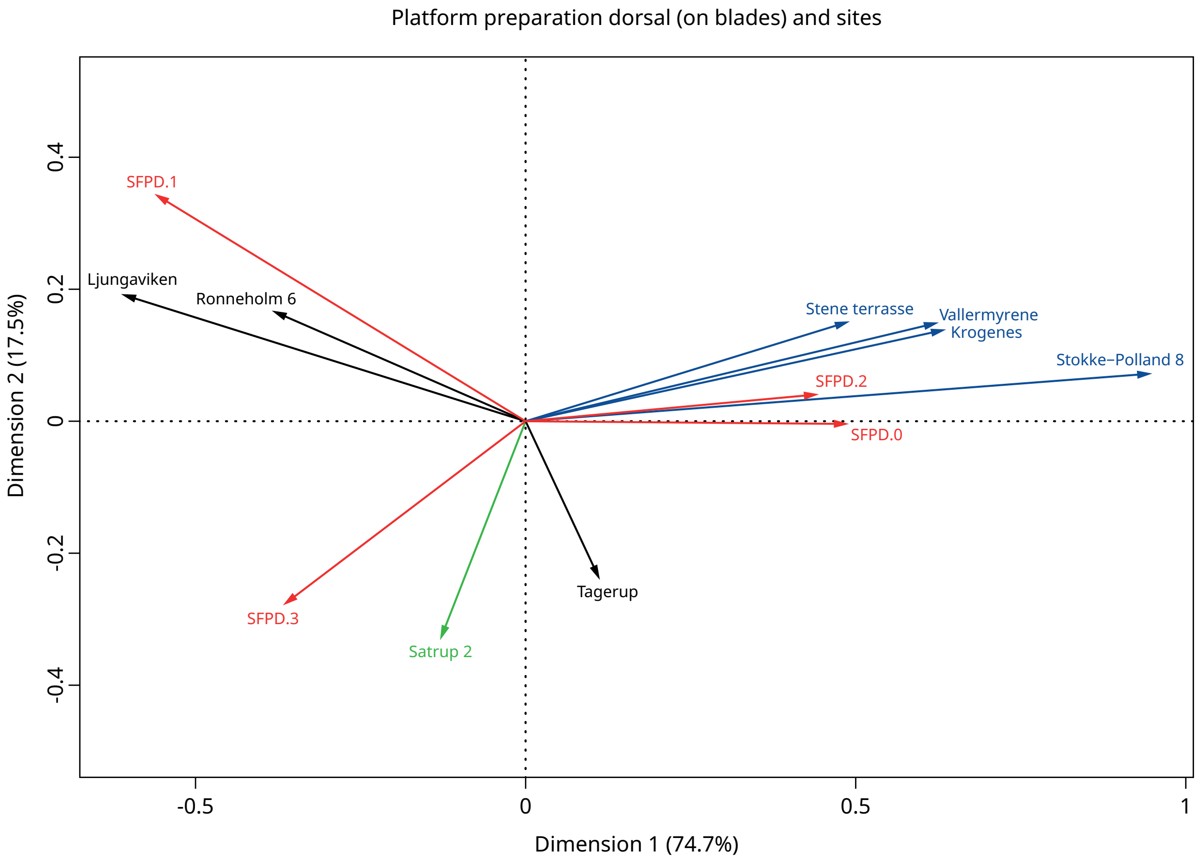


Figure 153. Correspondence analysis plot showing the correspondence (association) of attribute variations of platform preparation dorsal (SFPD, in red) with the sites in the research area in various colours (F2a in black, F2b in green and F3 in blue). Dimensions 1 and 2 are displayed. The length of the arrows and the angles between the arrows indicates the strength of the associations, with longer arrows and smaller angles showing stronger associations. Attribute morphologies include: SFPD.0 = no preparation, SFPD.1 = abrasion, SFPD.2 = trimming and SFPD.3 = trimming and abrasion.

the attributes SFPD.0 (no preparation) and SFPD.2 (trimming) and at the very top of the plot we find SFPD.1 (abrasion). It is not clear what this dimension reflects.

Attributes SFPD.2 and 0 are together located on the positive site of the plot, showing some association to each other, as well as to the sites Stene terrasse, Vallermyrene, Krøgenes, and Stokke-Polland 8. Clearly, there is a higher relative percentage of blades displaying no preparation or trimming among the sites from focus area 3. The angles between sites and attributes are all rather small and the length of the arrows also indicate strong associations, especially for Stokke-Polland 8, to both attributes. The closeness of these sites on the plot indicates a strong regional profile for these assemblages, relating to dorsal preparation.

The attribute SFPD.3 is located on the lower left part of the plot. Few sites are situated near this attribute, although Satrup seems somewhat associated with the attribute. Tågerup is located between SFPD.3 and 0, indicating weak associations to both attributes.

The attribute SFPD.1 is located on the upper left side of the plot, near the sites Ljungaviken and Rönneholm 6. Small angles and long arrows indicate that these associations are strong.

In this plot, some clear regional profiles become apparent. Focus area 3 has higher relative amounts of blades prepared using trimming, or that are not prepared compared to the other assemblages. Focus area 2a, instead, has higher amounts of blades prepared using abrasion. Few assemblages seem to be associated with the use of a combination of abrasion and trimming, although there seem to be some higher relative amounts in the assemblage from F2b. The assemblage from Tågerup seems generally varied, but it is hardly associated with the use of only abrasion at all.

Platform preservation (SFPE)

The acquired eigenvalues show that most information can already be found in the first dimension (76.5%). Most of the remaining information is then found in dimension 2 (18.9%). Both dimensions can be seen in figure 154. The first two dimensions thus provide a cumulated inertia of 95.3%, which provides a near complete idea about the available information. There is therefore no need to explore further dimensions. A more detailed view on which rows contribute to the different dimensions shows that the assemblages from Vallermyrene 4, Rönneholm 6 and Stokke-Polland 8 "determine" the first dimension, while the assemblages from Satrup 2 and Ljungaviken "determine" the second dimension.

On the x-axis, we see dimension 1. On the right side of the plot, the attributes SFPE.1 (remaining cortex) and SFPE.2 (smooth PF) are positioned. On the left, we instead find the attributes SFPD.3 (crushed PF) and SFPD.57 (faceted PF). It is not clear what this axis reflects.

Dimension 2 is found on the y-axis. On the bottom part of the plot, the attributes SFPE.1 (remaining cortex), SFPE.57 (faceted PF) and SFPE.2 (smooth PF) are located. The only attribute located at the positive part of the plot is SFPE.3 (crushed PF). Perhaps this axis reflects the presence/absence of a platform.

The attributes SFPE.1 and SFPE.2 are both located at the lower right side of the plot. The relatively close positions of the sites Tågerup, Rönneholm 6, Ljungaviken, Krøgenes and Stene terrasse indicate some association between remaining cortex on PF and smooth platforms and the sites from focus areas 2a and 3. However, the associations are rather weak, as seen by the short arrows.

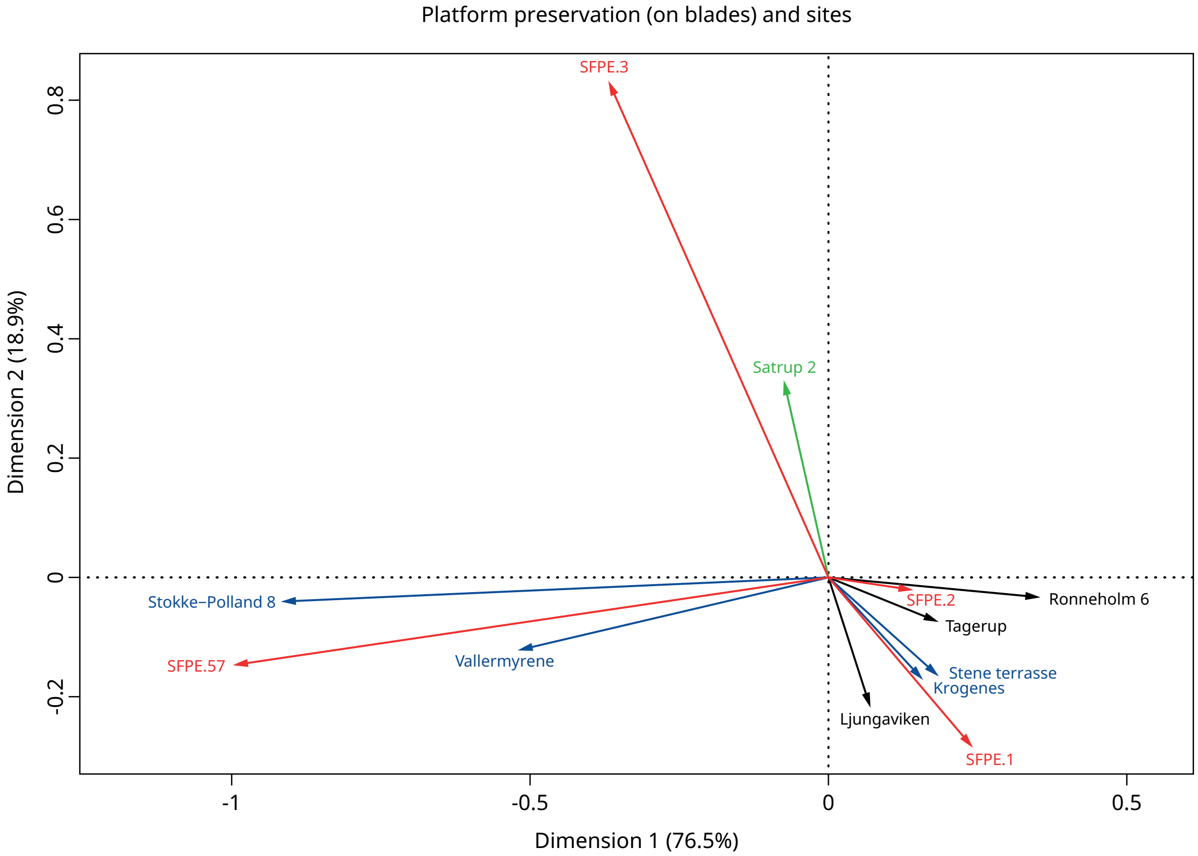


Figure 154. Correspondence analysis plot showing the correspondence (association) of attribute variations of platform preservation (SFPE, in red) with the sites in the research area in various colours (F2a in black, F2b in green and F3 in blue). Dimensions 1 and 2 are displayed. The length of the arrows and the angles between the arrows indicates the strength of the associations, with longer arrows and smaller angles showing stronger associations. Attribute morphologies include: SFPE.0 = not remaining, SFPE.1 = a natural surface, SFPE.2 = a smooth platform, SFPE.3 = crushed, SFPE.5 = faceted with two facets, SFPE.6 = faceted with two facets and tilted and SFPE.7 = faceted with more than 2 facets.

The attribute SFPE.57 is located at the lower left part of the plot. Nearby, the sites Stokke-Polland 8 and Vallermyrene 4 are positioned, both from focus area 3. Associations between faceted platforms and these sites are rather strong, especially for the assemblage from Stokke-Polland 8.

The attribute SFPE.3 is located at the upper left part of the plot. The only site with some association to crushed platforms is Satrup 2, although the short arrow indicates that the association is rather weak.

Cortex/natural areas (ACN) on cores and blades

The acquired eigenvalues show that most information can already be found in the first dimension (87.2%). Along with dimension 2, almost all the information is plotted (Fig. 155) with an accumulated value of 98.6%. Thus, there is no need to explore any further dimensions of the correspondence plot. A more detailed view on which rows contribute to the different dimensions shows that the assemblages from Lithuania, Tågerup and Dreggers 3 "determine" the first dimension, while assemblages Stanovoye 4 and Dreggers 3 "determine" the second dimension.

On the x-axis, we see dimension 1, representing 88.6% of the information in the plot. On the right (positive values), the attribute "no cortex" is found, while on the left side (negative values) the attributes related to some amounts of cortex are positioned. This axis therefore represents a presence-absence relationship relating to the cortex. Dimension 2, on the y-axis, represents 11.4% of the information. On the bottom of the plot (negative values), the attribute "half or more cortex" is positioned. On the top of the plot (positive values), the attribute "little cortex" is located. "No cortex" is

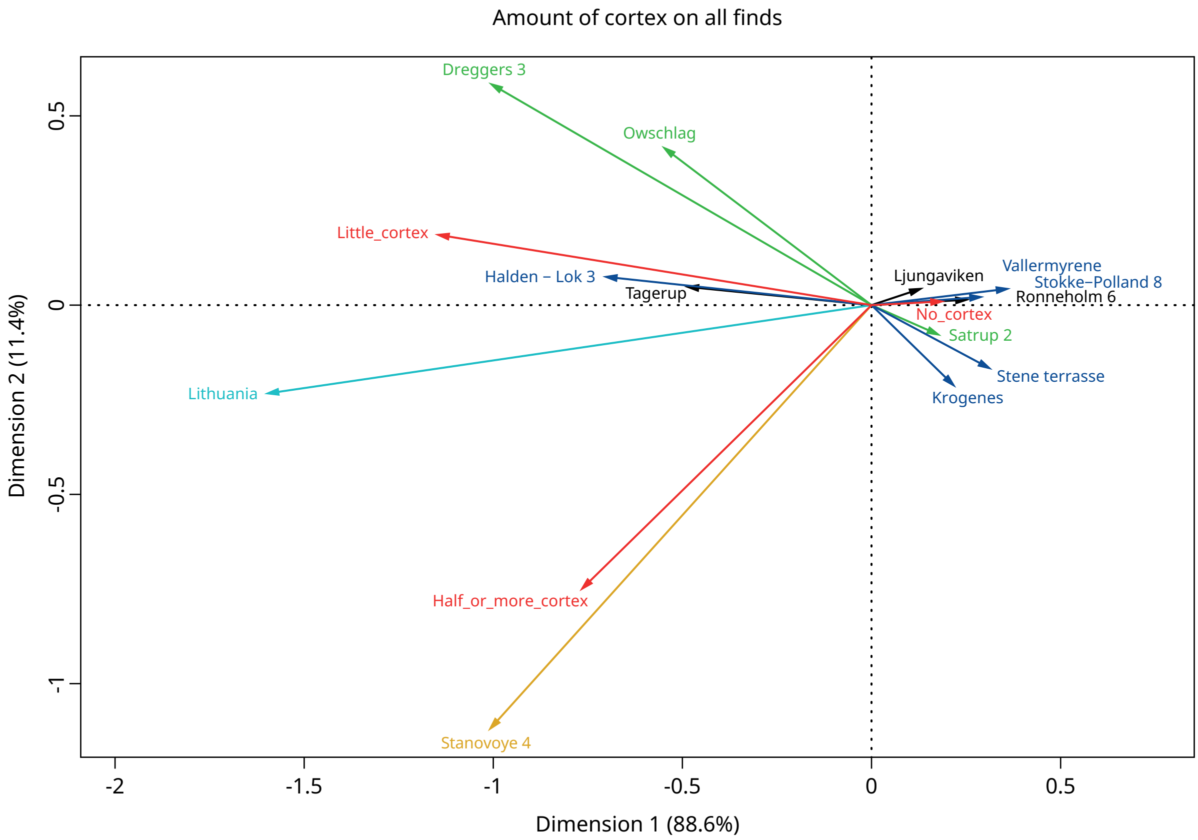


Figure 155. Correspondence analysis plot showing the correspondence (association) of attribute variations amount of cortex (ACN, in red) with the sites in the research area in various colours (F1 in mustard, F2a in black, F2b in green, F3 in blue and F4 in teal). Dimensions 1 and 2 are displayed. The length of the arrows and the angles between the arrows indicate the strength of the associations, with longer arrows and smaller angles showing stronger associations.

positioned relatively close to the latter, also in the upper part of the plot. Thus, this dimension seems to reflect the actual amount of cortex more closely.

The attribute “no cortex” is located on the right site on the x-axis. In close proximation to it, we find the sites Ljungaviken, Rönneholm 6, Satrup 2, Vallermyrene, Stokke-Polland 8, Krøgenes and Stene terrasse. Note that these sites relate to focus areas 2a, 2b and 3. The small angles between the red arrow for “no cortex” and the blue arrows relating to the various sites indicate that there is some association between the two, however, the shorter lengths of the arrows (*i.e.* their closeness to the origin) indicate that these associations are rather weak.

The attribute “half or more cortex” is found in the lower left side of the plot, in close proximity to the site Stanovoye 4. The small angle and long arrows relating to these points indicate a strong association between the two. Thus, it can be assumed that the assemblage from Stanovoye 4 shows a higher relative amount of finds with “half or more cortex” compared to the other sites. There is also some association between the assemblages from Lithuania and the attribute “half or more cortex”, although the larger angle between them indicates a lesser degree of association compared to Stanovoye 4.

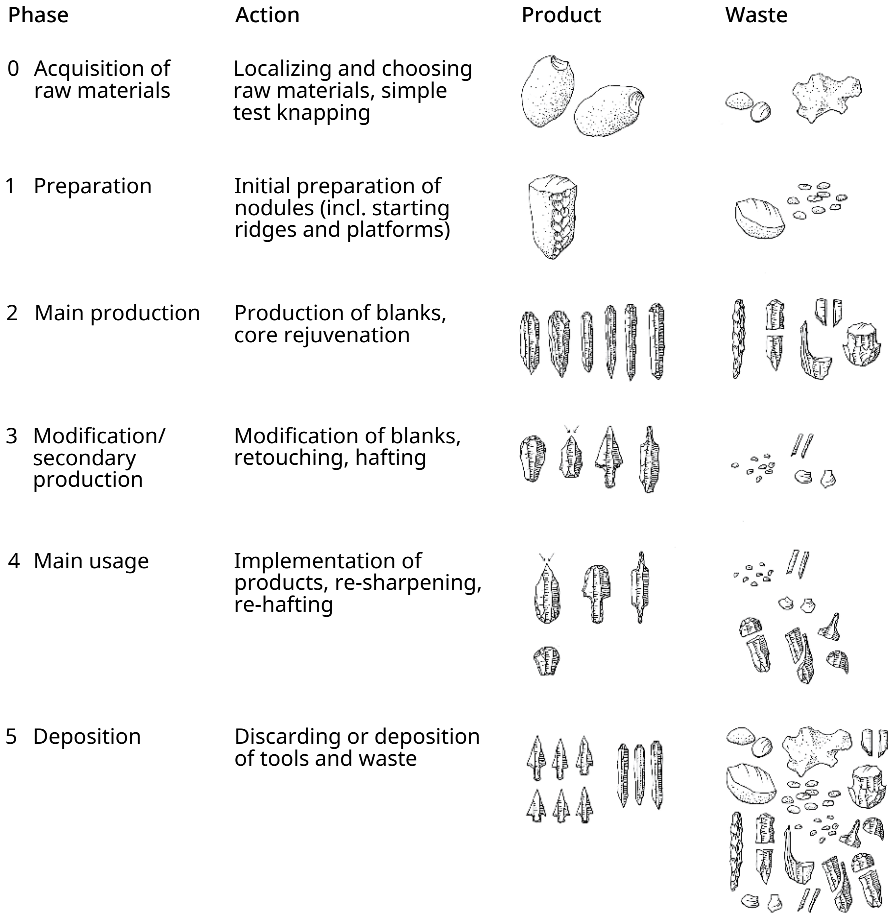
The attribute “little cortex” is found in the upper left part of the plot. Positioned near this attribute are the sites Dreggers 3, Owschlag, Halden-Lok 3, Tågerup as well as the Lithuanian assemblages. This positioning indicates that these sites have similar regional profiles dominated by larger relative amounts of “little cortex”. The longer arrows represented by Dreggers and Lithuania indicate a stronger association between these sites and the attribute. Shorter arrows to Halden Lok 3, Tågerup and Owschlag indicate that the associations between these sites and the attribute are weaker, although the angles are smaller.

The sites from focus areas 2a, 2b and 3 are mainly associated with the attributes “no cortex” or “little cortex”, although there is also some (weaker) association between the sites Halden Lok 3 and Tågerup concerning the attribute “half or more cortex”. The site from focus area 1 is mainly associated with the attribute “half or more cortex”. The Lithuanian assemblages are associated with the attributes “little cortex” but also with “half or more cortex”.

6.1.4 The blades – Approaching *chaîne opératoires* within the focus areas

In this section, the recorded and analysed data (described above) will be used to approach regional *chaîne opératoires* from the different focus areas. Relevant previous research will be used to fill in any gaps in the information from this study. The structure of the *chaîne opératoire* comes from Eriksen (2000, 81), which uses six phases to explain the production process, which will be described in detail below. Each phase includes the actions involved during that phase along with the produced items and waste (Fig. 156).

Phase 0 involves the acquisition of raw materials. Actions involved in this stage include localising available raw materials, either from the local environment or from further away. Raw materials can be found during specific raw material acquisition runs, during other activities or via trading. This stage also includes simple test knapping of the materials to check for its quality. During these activities, materials



Phase	Action	Product	Waste
0 Acquisition of raw materials	Localizing and choosing raw materials, simple test knapping		
1 Preparation	Initial preparation of nodules (incl. starting ridges and platforms)		
2 Main production	Production of blanks, core rejuvenation		
3 Modification/ secondary production	Modification of blanks, retouching, hafting		
4 Main usage	Implementation of products, re-sharpening, re-hafting		
5 Deposition	Discarding or deposition of tools and waste		

Figure 156. Illustration of the *chaîne opératoire* structure used in this subchapter, including the six phases with related actions, products and waste (after Eriksson 2000, 81).

produced include unused nodules with single flake negatives or those that were split open as well as flakes and fragments that are covered by cortex (Eriksen 2000, 81-82).

Phase 1 is the preparation phase. Here, the nodules are prepared for further knapping, which includes the preparation of platforms and ridges to act as starting points for blade or flake production. Products and waste related to this phase include core preforms, cortex flakes, platform preparation flakes and other larger fragments with cortex (Eriksen 2000, 81-82).

The preparation of the core platform often involves one of two methods, as described by Inizan (2012) and Takakura (2012). The *Horoka method* involves first knapping away a part of the nodule to produce the platform and subsequently preparing and shaping the core body. The *Yubetsu method* instead involves an initial bifacial shaping of the core body and subsequently the production the platform. The Yubetsu method commonly produces a more lens-shaped and narrow core, while the Horoka method produces a wider core (Inizan 2012; Inizan *et al.* 1999; Takakura 2012). Due to the bifacial shaping of the latter method, one can also assume that less cortex should be found on cores prepared using the Yubetsu method compared to the Horoka method.

Phase 2 involves the main production phase. Here, blanks in the form of blades and flakes are produced. The phase also involves core rejuvenation. Products and waste that are created include, for example, flakes and blades, platform preparation flakes, frontal rejuvenation flakes, crested blades and exhausted cores (Eriksen 2000, 81-82). During the main blade production phase, the core has to be immobilised in some way. This can be done by holding the core in the hand or by placing it in a holding device. Retouch placed on the lateral sides of the core has been interpreted as an indicator for the core being attached in a holding device (Sørensen 2006), but it has also been interpreted as an indicator for hand-held blade production (Callahan 1985). A better indicator for the method of holding the core may therefore be the presence or absence of blade twisting (TWIST). Blades are more likely to twist if the core is not stable during knapping and vice versa (Damlien 2016a; Berg-Hansen 2017). Since a holding device will usually hold the core more stable than the hand, we can assume that blades without signs of twisting are more likely to have been made from a core that is attached in a holding device.

Three attributes have proven to be especially useful in the interpretation of implemented knapping techniques. These are blade regularity, conus formation and interior platform angle (Damlien 2015). The two former attributes were recorded in this project (REG and KE) and will therefore be used as a basis for an interpretation of the knapping techniques used in this focus area. The measurement of the interior platform angle was not recorded for the blades due to the issues related to the ambiguity of measuring of this attribute (cf. Cochrane 2003). Instead, the angle between the core front and the platform (EPANG) is used as an indicator for this.

Phase 3 is the modification phase, or secondary production, which includes the modification of blanks in the making of more elaborate items, such as retouched items (knives, scrapers, arrowheads *etc.*). Products and waste created include both finished retouched items as well as retouch waste, such as microflakes/splinters, micro burins, burin flakes and broken blanks – since it is easy to break the blanks during modification, especially with less experience (Eriksen 2000, 81-82).

Phase 4 is the main usage phase. While the products are being used, they become less sharp and they break, which leads to actions such as sharpening/resharpening, hafting/re-hafting or reusage as something else. Products and waste include the same as in phase 3, with additional retouch flakes and other remains from the rejuvenation of tools (Eriksen 2000, 81-82).

As this study is aimed to understand the main blade production phase, the reshaped blades have not been included in the material analyses. Therefore, phases 3 and 4 of the *chaîne opératoire* can only be understood in view of previous research and mapping which types of microblade tools were available in the different sites and focus areas. When discussed below for each focus area, these phases will be discussed jointly as they involve a lot of the same products and waste.

Phase 5 includes the deposition phase, in which tools and waste are discarded, accidentally dropped or purposely placed for storage (Eriksen 2000, 81-82).

6.1.4.1 The *chaîne opératoire* in focus area 1 – Stanovoye 4

0. Acquisition of raw materials

Raw materials were, to a high degree, collected from the local area, as seen by the dominance of local poor-quality flints and some chert in the recorded data from Stanovoye 4. The small cores, often with remaining cortex, show that the size of cores corresponds to the available local flint nodules (Zhilin 2003; 2006). The higher amounts of remaining cortex on the core sides (as seen in figure 155) also indicate that an effort was made to implement as much of the already small nodule as possible.

1. Preparation phase

The preparation of the cores from F1 is done in several stages. Firstly, by creating a platform on the nodule in accordance with the Horoka method. An implementation of the Yubetsu method cannot be supported in the data from Stanovoye 4 due to a lack of bifacial shaping of the core body, a varied but generally wide cross-section of the core as well as the common presence of remaining cortex (seen on 18.5-19.2% of core sides).

After the creation of the platform, the sides of the core were prepared. This was mainly done by removing multiple flakes or a single large flake, using direct technique from several directions (18/27 on KS1 and 19/26 on KS2). Larger flakes were sometimes used as a core, rather than a nodule (7/26 cores). In these cases, the general shape of the flake remains, except for the addition of a platform and the front. The cores from F1 were commonly prepared with one single front (23/27 cores).

2. Main production phase

A few cores display the presence of lateral edge preparation on the core sides (KS). It is slightly more commonly found on KS1 (4/27 core sides) than on KS2 (2/26 core sides). The presence of these attributes on some of the cores from Stanovoye 4 indicates that a small number of cores have been placed in a holding device. However, compared to focus areas 2a, 2b and 3, Stanovoye 4 has a much lower number of cores with this attribute, which indicates a difference in core holding style between these areas.

Since it was not possible to record the blades from Stanovoye 4, the methods and techniques involved in the blade production cannot be fully analysed. Nonetheless, some attributes on the cores can provide indications regarding the implemented knapping techniques. One such attribute is the angle between the platform and the core front (EPANG). The cores from Stanovoye 4 have actual front-platform angles spanning 55-95 degrees, with most of them between 70-90 degrees (21/27 cores). When these measurements are converted to reflect the blade interior platform angles (IPA) of the blades produced from the cores, it becomes clear that the interior platform angles of 90 degrees or more would have been possible from 88.9% of the cores. This would suggest that pressure technique and/or indirect technique may have been used to detach blades from these cores. However, the core-platform angles on these cores reflect the final stage of the core usage which might not correspond to the angles used during the main production phase. The interpretation of this attribute should therefore be considered alongside the other blade/core attributes.

Traces on the core front relate to the methods used to prepare the core front prior to blade detachment. The traces of this process are referred to as core front preparation (PPCD) and can be seen in the form of trimming, abrasion or a combination of them. The cores from Stanovoye 4 most commonly have remains of trimming on the front of the core (13/32 core fronts), trimming located on the platform near the front (7/32 core fronts) or trimming which is located on the front as well as on the platform near the front (6/32 core fronts). Trimming is a common manner of removing the overhang on the front, although few other assemblages in this study contained cores with trimming located on top of the platform. However, it appears as if this preparation is related to the general preparation of the platform (PMORPH) as a faceted platform. Other assemblages with facetted platforms to not display this pattern, as will be discussed later in this chapter. Thus, this seems to be a cultural and/or individual choice by the knappers at the site or in the region.

The remaining cores display no preparation (5/32 core fronts), while one core has traces of a combination of trimming and abrasion (1/32 core fronts). Different variations involving trimming were preferred at the site, while other manners of frontal preparation were only done in modest amounts. These variations suggest a non-standardised manner of frontal preparation for the site. However, the small sample size may make these patterns appear stronger than they are. Moreover, they may reflect only a small number of knappers with individual strategies for core preparation.

The core platforms are commonly faceted (25/29 cores) or partly faceted (1/29 cores), but smooth platforms also appear in low numbers in the assemblage (3/29 cores). This is likely a reflection of both a core rejuvenation strategy and the maintenance of a core during blade production. Maintaining a relevant core front angle is a necessity to keep the core in use, but the manner of which it is done is a cultural or individual choice, since the same result can be obtained in several different ways. Whether or not this strategy was used to remove as little raw material as possible from the already small cores, or if it is simply a cultural choice (or both), is not clear.

The findings of both smooth and faceted platforms in the assemblage could also reflect different stages in the core preparation process. For example, the initial platform might have been smooth, only to become faceted later in the knapping process as the core underwent continuous rejuvenation. The current material basis is not substantial enough to rely on it for a comprehensive understanding of the blade production process from these cores. No rejuvenation flakes (frontal or from a platform) were found or recorded.

3-4. Modification and use

Previous research has indicated that some of the blades produced from single-fronted cores at the Stanovoye 4 site were modified to become inserts for bone points (Zhilin 2015). Often times, the inserts remained as blanks but examples of retouched inserts also exist (Savchenko 2010).

To access the process involved in the modification and usage of the blades, previous works on bone and lithic technology from the Upper Volga region can be used (cf. Zhilin 2015). The general process is also similar to how slotted bone points were produced in the Eastern Ural area (cf. Savchenko 2010; 2019). These analyses provide a good overview of the part of the *chaîne opératoire* related to the making of the bone points, including hafting and attachment of inserts. According to these studies, the bone points themselves were made from long bones (often from *Alces alces*) which were soaked, cut, and splintered using a groove and splinter technique. Then they were grooved, scraped and/or whittled. Subsequently, details such as barbs, grooves or slots for inserts were added. Slots were grooved using burins. Any ornamentation was also added at this stage. Prior to the attachment of the inserts, the bone point underwent grinding and polishing (Savchenko 2010; Zhilin 2015). A similar process has been described for two slotted bone points (stray finds) from an area near Vilnius in Southern Lithuania (Ivanovaitė *et al.* 2018), as well as for bone points from the Eastern Ural area (Savchenko 2010; 2019). Parallels in the manner of bone point technology have been observed for several parts of Eastern Europe (Savchenko 2019).

Slots were then filled with glue made from some combination of pine and spruce pitch, charcoal, beeswax and ash. After filling, the artefact was heated over hot charcoal until the glue softened. At this point, the inserts were attached into the slots and any overflow of glues was removed by longitudinal shaping (Zhilin 2015). The use of a viscous black glue, similar to birch pitch tar, to attach the inserts in the bone point groove has also been observed on the Lithuanian materials (Ivanovaite *et al.* 2018). The inserts from the Upper Volga were placed to form a very straight and even cutting edge. In some cases, the blade inserts were broken into fragments to better create a continuous edge. On several sites in the area, it has been observed that inserts were placed with the dorsal side up on one side, and with the dorsal side down on the other. After the glue had hardened, the artefacts were ready for use (Zhilin 2015).

Use wear traces on the inserts have indicated that the slotted bone points were used as projectile points during hunting and that when not in use they might have been stored in a quiver along with other arrows, as seen by chipping and abrasion on the insert edges (Zhilin 2015). Edge rounding and extensive damage on the inserts from Southern Lithuania indicate that these artefacts were repeatedly used and in contact with hard materials, such as bone, before discarding (Ivanovaite *et al.* 2018).

5. Deposition

The bone points and cores relating to the HCC are commonly found on the settlement sites in the area. These settlement sites are usually found on old lake sites which end up as bog sites with conditions that are beneficial for the preservation of organic remains. Therefore, one might assume that the distribution of slotted composite weapons is determined to a great extent by the preservation conditions, rather than the distribution of people who implemented the concept.

6.1.4.2 The *chaîne opératoire* in focus area 2a – Southern Sweden

0. Acquisition of raw materials

All assemblages from focus area 2a consist of flint. These flints are readily available in many areas of Southern Scandinavia as moraine deposits, outcrops and on beaches. Although the secondary deposits generally involve smaller nodules than from primary sources, they are often available in large sizes within the focus area (Högberg and Olausson 2007, 18-23).

Although the different types of flint have not been recorded in this project, previous investigations have highlighted the use of a variety of flints in F2a. The Ljungaviken site contains flint from Southern Scandinavia (including both Senonian and Danian flints) and more specifically from the Eastern part of Scania (a local flint known as Kristianstad flint) (Kjällquist and Friman 2017, 18-21). On an overview basis, it can also be concluded that the flints from Rönneholm 6 consist of both Senonian flints and other types that are not available in the immediate vicinity of the site but that are available regionally (Sjöström 2004, 12). Furthermore, the flint from the Tågerup site is dominated by Senonian and Danian flint (Karsten and Knarrström 2001, 304). The flints from the focus area are thus collected locally as well as acquired regionally through trade or large-scale efforts to gather raw materials.

The finds recorded from Ljungaviken mainly consist of Senonian and Danian flints (79%), while the rest is represented by Kristianstad flint. The latter was, to a large extent, used for the larger blades, while smaller blades are mainly made from Senonian and Danian flints, which could be explained by the coarser character of the Kristianstad flint and its mixed quality (Kjällquist and Friman 2017, 18-21).

1. Core preparation phase

The first step in the preparation of the core is the creation of a platform, which is done according to the Horoka method. This is clear from the lack of bifacial shaping of the core body, a wider cross section and the presence of remaining cortex on the sides and back of many cores (ranging from 22-40% of the cores). Most cores from the focus area have one single platform (KSFA). A second platform was only created in some cases if specific issues led to the discarding of the first one (KSFN).

After the creation of the platform, the core sides and back were prepared. The back of the core was commonly shaped by removing multiple flakes (66.2% of cores). Similarly, flakes were also removed from the core sides (58-61%).

Just prior to the start of blade production, a core front was placed at one end of the initially elongated cores (KAAN). Single cores with additional fronts exist in the assemblages from Ljungaviken and Rönneholm, while a secondary front is more common on the cores from Tågerup (9.7%). This could reflect a regional variation or possibly a result of sample size effect.

A further look at the remains from the early stages of blade production can, however, provide some additional insights into the efforts of frontal shaping in relation to the early blade production. In the assemblage from Tågerup, 7% of the blades have remaining cortex (DBF) which indicates that the primary/secondary blades were knapped from a rather unprepared front which was still largely covered by cortex. Some single blades from the site show that cresting was also done as a means of core front preparation. A similar trend is seen for Rönneholm 6, where 1% of blades have remains of cortex indicative of blade production from a largely unprepared front. A small number of blades with cresting also exist within the assemblage. The blades recorded from Ljungaviken do not show any cortex remains or remains of cresting. However, the small number of recorded blades with this attribute from the assemblage is not representative of the assemblage in general.

Nodules were mainly used as a base for the cores (81% of cores), while the rest is represented by the use of flakes as cores.

2. Main production phase

The use of pressure technique for blade production at Tågerup has already been indicated by the presence of pressure tools as well as by descriptions in previous technological studies of the site (Karsten and Knarrström 2003, 48). At Ljungaviken, blade production using pressure technique, along with finds relating to the production of composite tools, has also been suggested based on the presence of small and regular blades, handle cores, burins with use-wear traces of bone working, scrapers with remains of wood-working as well as remains of pitch on a scraper (Kjällquist and Friman 2017, 53, 94). The blades from the hut at Rönneholm 6 have not been specifically described as produced by means of pressure technique, although the handle core concept has been previously confirmed in the assemblage from this site (Sjöström 2004, 15).

A closer look at the regularity (REG) of the blades from the three recorded assemblages shows that the combined percentages of regular and extremely regular amount to 84.8% from Tågerup, 84.9% from Rönneholm and 77.2% from Ljungaviken. Overall, this level of regularity indicates that pressure technique or indirect technique was implemented for blade production. Since both regular and extremely regular blades make up most assemblages produced with pressure/indirect technique (cf. Damlien 2015), regularity alone cannot provide a clear indication of which of the two techniques was used for these blade assemblages. Furthermore, the interpretation of a blade as “regular” or “extremely regular” is also somewhat subjective, which can lead to biases in recording by different researchers. The slightly fewer regular blades from Ljungaviken are likely explained by the difference in recording strategy for the assemblage (see Chapter 5.2).

The presence of conus formation (KE) is not a common attribute among the assemblages. This attribute is lacking on 78.7-86.2% of the blades from the focus area. This strengthens the theory that pressure technique was largely used to produce these blades.

For the cores at Tågerup, the actual front-platform angles (EPANG) are most varied, spanning from 65-115 degrees, compared to 70-100 and 75-100 degrees on Rönneholm 6 and Ljungaviken, respectively. However, on all sites most blades (>80%) have an angle of 70/75-100 degrees, which translates to an IPA of ca. 80-105 degrees. These numbers are indicative of the use of pressure technique on most of the blades.

Based on the recorded front-platform angles, and their corresponding IPA's, it seems that most blades from the recorded cores were produced using pressure technique, or possibly (in part) by indirect technique, although these measurements are taken from already discarded cores and therefore do not perfectly reflect the angles used during the main blade production phase. It should be assumed that at least some of the cores were discarded due to a faulty frontal angle. Overall, the front-platform angles of the cores from the focus area, along with blade regularity and presence of conus formation, indicate that blades were most likely produced using pressure technique, although the presence of blades produced using indirect techniques cannot be completely excluded in the assemblages.

The data related to the twisting of blades (TWIST) showed a similar pattern in all assemblages. A lack of twist is most common, amounting to between 64-69% of blades from each site. This would indicate that the cores were generally stabilised during the production of most blades, although the 31-36% of blades that were nonetheless twisted could be explained by, for example, different types of (more or less stable) holding devices, inconsistent use of a holding device or possibly varying knowledge and/or know-how.

During the main production phase, the core front was in constant need of preparation to remove the overhang from previous detachments and to help strengthen the platform for the next blade detachment. When this attribute (PPCD) is studied on the core fronts in the focus area, the two most common manners of front preparation were trimming (52.7%) or a combination of trimming and abrasion (29.3%). This was followed by the use of only abrasion (11.3%) or by a lack of preparation (6.7%). When the same attribute is studied on the proximal part of the blades (SFPD), a slightly different pattern is apparent. Here, a combination of trimming and abrasion is mostly found (35.2%), followed by almost equal amounts of trimming (29.9%) and abrasion (29.2%) and subsequently by a lack of preparation (5.7%). Some local differences between the sites can be seen in the manner of platform preparation, which will be discussed further in Chapter 7.2.2.

Additionally, core rejuvenation was a necessary step to remove any mishaps during blade production, such as hinge breaks, or to adjust or rejuvenate the angle between the core front and the platform. The rejuvenation strategy in the focus area can be indicated by the platform morphologies (PMORPH). The cores from Rönneholm 6 all have smooth platforms, while the cores from Ljungaviken are more commonly faceted or partly faceted (6/10 cores), although the small sample size makes comparisons somewhat complicated. The cores from Tågerup are almost equally divided between having faceted or partly faceted platforms and smooth platforms. Thus, there seems to be some variation in the style of core rejuvenation in the focus area.

A core rejuvenation strategy can also be confirmed through the finds of rejuvenation flakes, knapped from the core front or the core platform. From Ljungaviken, two platform rejuvenation flakes (find no. 243 and 248) and three frontal rejuvenation flakes (find no. 327, 643 and 619) were recorded. From Tågerup, only a small amount of the whole collection was recorded but nonetheless both varieties of rejuvenation flakes were found and recorded (frontal rejuvenation flakes: find no. 16766:168, 23280:80, 11952:113 and platform rejuvenation flake: find no. 13187:1). From Rönneholm 6, core rejuvenation is only represented by frontal or side/front rejuvenation flakes (find no. 21801, 17155, 9291, 17197 and 24858).

3-4. Modification and use

The artefact assemblage from the hut at Rönneholm 6 does not provide a good idea about what the handle core blades were used for in the later stages of the *chaîne opératoire*. Although, on the adjacent Rönneholm 7 site, which had a direct relationship to Rönneholm 6 (as seen by refittings), the presence of two narrow blades with remains of pitch indicate that a composite tool of some sort has existed on site. Additionally, the presence of narrow microliths (Swe: *snedpilar*) and other narrow retouched blades from Rönneholm 8 might also result from blade production from handle cores. This would indicate that various tools may have been made using the blades from handle cores (Sjöström 2004).

The finds relating to Hut 3 at Ljungaviken have been interpreted as belonging to several activities, including the production of slotted bone points, which is seen by the presence of small blades, pitch and the presence of use wear indicative of wood and bone/antler processing (Kjällquist and Friman 2017, 53). An additional indicator of this activity can be seen on one of the blades from the hut, which has use wear traces indicative of having been attached to a point. Furthermore, the remains of pitch on a scraper from the same context support this notion (*ibid.*, 58).

Contrary to the two other sites in the focus area, the assemblage from Tågerup represents a more varied assemblage, accumulated over a long period of time. This affects the possibilities of interpretation for the recorded finds since they are less limited both temporally and contextually. Nonetheless, the roughly 10,000 microblade finds from Tågerup indicate that the use of the handle core concept (along with other blade production modes) was implemented for blade making during a significant amount of the site history. However, even though the preservation conditions for organic remains at Tågerup were good, very few slotted bone points were found in the assemblages, which indicates that they were either not made/used in great numbers, or they were deposited elsewhere (Karsten and Knarrström 2003, 65). The ca. 30 bone points (slotted and otherwise) that were recovered from the Tågerup site were mainly made from deer long bones, which were shaped using burins and truncated blades (Karsten and Knarrström 2003, 64-65). The blade inserts were often used as blanks, without any retouch, and fastened using birch resin which was heated and chewed (*ibid.*). Slotted bone points have an assumed implementation within different forms of hunting, for example, as projectiles or shafted weapons. Experimental studies have shown that a slotted bone point acts in two ways, through both penetration and cutting, which when shot at an animal will cause a lot of bleeding as well as the cutting of nerves and tendrils, commonly leading to a quick death of any sized prey (*ibid.*).

The retouched small blades found on Tågerup are typologically distinguished as trapezoid microliths (59%), followed by rhombic microliths (31%) and oblique transverse arrowheads (3%). The first type is common during the early parts of the Kongemose phase (Blak), while the other two are from a slightly later phase (Karsten and Knarrström 2003, 59). The sizes of the microliths are varied (*ibid.*, fig. 36, 62-63) and some are similar in size to blades from handle cores. These retouched blades were probably used as the tip of a wooden arrow and shot using a bow, possibly a long bow (*ibid.*, and sources).

The small blades from the site are assumed to have been used in slotted tools (Karsten and Knarrström 2003, 64-65). However, only a few fragments of slotted bone points were found at the site and they were not part of an in-depth technological investigation. However, it is assumed that the bone points were shaped using burins and the slots were made using truncated blades. The inserts were then attached using birch resin which was heated and chewed. Resin remains from the site support this notion (*ibid.*).

5. Deposition

Although the assemblage from Tågerup resulted from many years of settlement history, there are more temporally limited contexts from the site. One such example is Grave 1. In this grave, the body of an elderly woman was found, along with some flint and bone finds. In relation to the grave, a posthole was found, which has been interpreted as a grave marker which was placed at the time of the burial or soon thereafter. The posthole contained more finds, including one handle core (Fig. 157; Kjällquist 2001). The core and remaining finds have been interpreted as grave goods. A temporal relationship between the grave and the posthole is clear due to the presence of a flake within the grave filling that is highly likely to have come from the handle core in the posthole (*ibid.*). The handle core and flake are both made of a non-local type of flint (banded Falster flint) and although the flake and the core could not be refitted (during my recording of the finds), the rare and non-local character of the raw material of both finds nonetheless indicate that the flake was knapped from the core during an earlier stage of the knapping process. In addition to the finds from Grave 1, a slotted bone point was also found in Grave 5 on the site (*ibid.*).

The large number of handle cores and microblades on the sites, and on Late Mesolithic sites in the region in general, indicate that blade production from handle cores was extensive. However, the large number of blades does not match

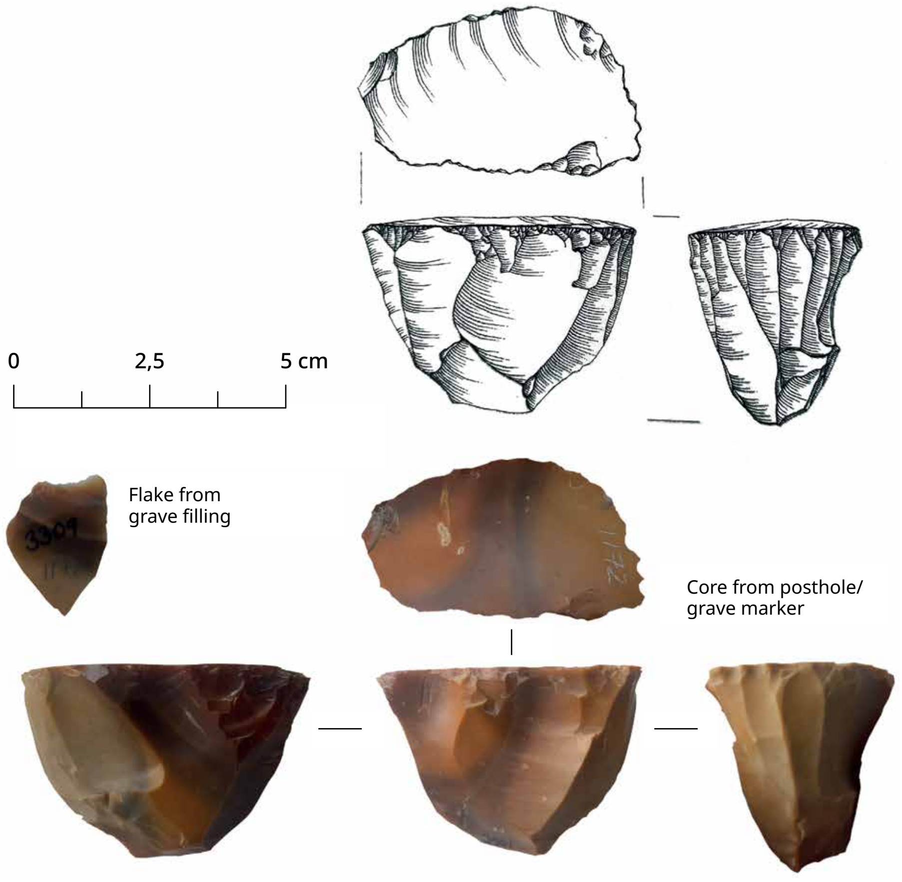


Figure 157. Drawing of the core (from Kjällquist 2001, 40, fig 5) and photos of the same core with its related flake (from recording).

the small number of composite tools (with flint inserts or microliths) that are found on these sites. There could be several reasons for this, for instance, due to the poor preservation conditions for organic finds. Although, if underrepresentation would be only a result of taphonomic conditions, one would still expect more finds of inserts with remains of pitch (as in Hut 3 at Ljungaviken or from Rönneholm 7, situated near Rönneholm 6) on the settlement sites. Instead, it is likely that blades were produced in larger amounts that were largely discarded, or used as blanks for cutting/scraping, only keeping a small part of the production remains for use in composite tools.

6.1.4.3 The *chaîne opératoire* in focus area 2b – Northern Germany

0. Acquisition of raw materials

All assemblages from focus area 2b consist of flints. Various types of South Scandinavian flints are readily available in the local landscapes of Northern Germany as secondary depositions by the extending ice sheet during the Weichsel glaciation, although regional flint sources can also be found, for example, on Rügen and Heligoland (Högberg and Olausson 2007, 51; Högberg *et al.* 2014). Nodules of different sizes can be found in the moraine deposits as well as on beaches in large amounts (Högberg and Olausson 2007, 18-23).

The handle cores from this focus area are entirely made from nodules, rather than large flakes, but it is possible that the smaller sample size from this area (22 cores recorded for this attribute) affects this pattern.

1. Core preparation phase

The first step in the preparation of the core is the creation of a platform, which is done according to the Horoka method. This is clear from the lack of bifacial shaping of the core body, a wider cross section and the presence of remaining cortex on the sides and back of many cores (ranging from 25-48.9% of cores). All cores from the focus area have one single platform (KSFA).

After the creation of the platform, the core sides (KS1 and KS2) and back (KR) were prepared. The core sides were often prepared through the removal of flakes, sometimes in combination with an additional side edge preparation, which will be discussed for each individual site. The core sides in the assemblage from Dreggers LA 3 are mainly prepared though the removal of flakes (10/36 core sides) and most core sides with additional side preparation (21/36). At Owschlag, the small number of recorded core sides shows either multiple flake negatives or one single flake negative, some with additional edge preparation (2/3 core sides). The small number of cores from Satrup displays either multiple preparation negatives or one large flake negative. Additional lateral edge preparation is found on 4/10 core sides. These patterns indicate that the manner of core side preparation is rather uniform within the focus area, although the assemblages are generally small, especially for the sites Satrup and Owschlag which are represented by 5 or less cores for each attribute. The presence of edge preparation in each assemblage could be an indicator that a holding device was used on these cores as well.

The core backs (KR) from Dreggers are mostly prepared using multiple flake removals (64.7%), while the rest still has remaining cortex. The cores from Satrup are all prepared by the removal of several flakes and the (two) cores from

Owschlag have either cortex or multiple flake removals. The preparation of the cores from this focus area is clearly focused on preparation by means of flake removals, both for the core sides and back.

Just prior to the start of blade production, a core front was prepared at one end of the elongated cores (KAAN). Only one single core with an additional front exists in the assemblages from Dreggers LA 3. On this core, the second front is placed on the opposite end of the platform across from the first front.

The preparation of the initial core front can be indicated through a look at the dorsal blade faces (DBF) from the sites. Unfortunately, blades from this focus area are all from one site, Satrup LA 2, which provides a very local view on the core preparation and blade production, rather than a regional one. Nonetheless, the blades from Satrup come mainly from the main production phase, as seen by the dominance of blades with 2-3 dorsal faces (83%). This is a common pattern since blades produced during the early phase of blade production are few compared to the many blades that can be produced through the life cycle of the core. The presence of cortex or cresting on the dorsal faces of blades are more interesting traits. In focus area 2b, 7.7% of the blades display cortex on the dorsal face, which indicates that blades were to some degree produced from an initially unprepared core front. Furthermore, the presence of cresting is seen on 2.5% of the blades, which shows that this was another strategy used to create a first ridge to act as a starting point for blade production.

2. Main production phase

The blades from Satrup LA 2 are almost equally divided between blades with twist (45%) and blades without twist (55%). This could indicate that the method for holding the core partly lacked stability, although at this point there are no experimental results indicating the ratio of twisted/non-twisted blades from stable and unstable cores, respectively. A better understanding on whether twisted blades can be produced from stable cores and vice versa would be beneficial in order to understand these attribute variations. Until now, we can only conclude that both twisted and non-twisted blades exist in the assemblage and that this would indicate blade production from both stabile and unstable cores. Perhaps different types of holding devices, inconsistent use or varying levels of knowledge and know-how contributed to these results.

Since no blades were recorded from Dreggers LA 3 or Owschlag LA 183, as a part of this project, only the blade data from Satrup LA 2 will be used to approach the knapping technique in this focus area, along with the core data from all sites. The cores from Dreggers make up most of the recorded assemblage from the focus area. Most cores from this site have IPAs of between 90-100 degrees (62.2%), which is indicative of pressure technique, or possibly indirect technique. A single core from Owschlag has an IPA of 100 degrees, and the four cores from Satrup all have IPAs of around 90 degrees or larger, which also indicates that they were used as a basis for pressure blade production.

The blades from Satrup LA 2 are most commonly regular (75.6%) and a large portion of the assemblage lacks any form of conus formation (73.7%). These attribute morphologies support the use of pressure technique, or possibly indirect technique, for blade production. However, it needs to be stated that these measurements are taken from already discarded cores and therefore do not perfectly reflect the angles used during the main blade production phase.

Prior to the removal of each blade, the core front was prepared by removing the overhang from the previous removal. This was done through trimming, abrasion or a combination of the two. The remains of this action are seen both on the core front (PPCD) and on the proximal dorsal part of the blades (SFPD). On the Dreggers cores, frontal preparation (PPCD) most commonly comes in the form of trimming (86.8%). Only small amounts of cores show any other type of preparation and most of the remaining cores have no preparation (11.3%).

According to the preparation remains on the blades (SFPD) from Satrup LA 2, the most common preparation was both trimming and abrasion (46.6%) followed by only trimming (32.8%). These differences could be due to local variation between the two sites or a difference in recording strategy and prior knowledge (as Dreggers was a part of a preliminary study). Additionally, these differences could also relate to the different stages of preparation, since preparation was mainly done immediately prior to blade production and thus quickly removed from the core.

The core rejuvenation strategy within the area can be indicated by the platform morphology (PMORPH). The cores from the focus area commonly have smooth platforms (between 83-100%) with only very small numbers of cores that are faceted (3-17%) or partially faceted (0-12%). This indicates that a lot of the rejuvenation was done by removing flakes from the front and sides of the cores. This was further supported by a single find of a frontal rejuvenation flake in the assemblage from Satrup LA 2 (find no. 1914,1). However, the core assemblages from Owschlag and Satrup are small, making comparisons difficult.

Overall, local comparisons between the three assemblages from this focus area are extremely difficult due to the small number of cores from Satrup and Owschlag and the lacking blade assemblages from Dreggers and Owschlag.

3-4. Modification and use

For the sites in this focus area, the later stages of blade production from handle cores becomes even more complicated as one of the sites (Dreggers) is a surface collection of a palimpsest site. The finds that are included in this collection span a long time period that includes Mesolithic and Neolithic finds. Therefore, little can be said about the further working of the handle core blades from here. The Owschlag site is a small site with a small inventory, but it nonetheless contains retouched blades of various forms, including scrapers, burins and microliths in the shape of narrow triangles and trapezes (Bokelmann 1971). Based solely on the find illustrations from the site (*ibid.*), it seems that the narrow microliths are produced from more narrow blades (likely from handle cores) than the trapezes, which appear to be made from larger blades. If this is the case, it would indicate that the blades produced from handle cores were used for triangular microliths, while larger blades were used as a basis for trapezes at the site. This has not been thoroughly investigated and further technological studies are necessary to explore the earlier stages of different microlith types in general.

The most comprehensive assemblage in the area is that from Satrup LA 2. The relevant inventory from this site consists of handle cores, small regular blades, and microliths in the form of simple points and narrow triangles (Briel 2016). Within the scope of the current project, a portion of the narrow blades and retouched blades from the site were technologically compared to understand the relationship between them and the choices involved in the *chaîne opératoire*. The studies showed that the narrow microliths were straighter and more regular compared to the narrow blades. Additionally, blades with cortex were completely excluded from the assemblage of narrow microliths. This indicates that blades with these attributes were prioritised for further working into microliths. The retouch on these microliths was commonly located along the full length of the blade (70.6%), on the right side seen from the direction of percussion (70.6%), on the dorsal blade side (100%) and parallel to the sides of the blade (94.1%). At this stage, it is not clear what type of tools the microliths were implemented in, although it is probable that they were used in a hunting-context, perhaps as inserts in a slotted bone point or as arrowheads.

In general, very few slotted bone points or other composite tools have been found in the area (Hartz 2009), even though handle cores are a common find in the private surface collections in the area (personal communication S. Hartz, 2017). This could largely be due to the poor preservation conditions for organic remains due to the sandy soils across Northern Continental Europe, although some landscape types in Northern Germany have offered better preservation conditions (Groß and Lübke 2019). However, few later Mesolithic sites have been found in these conditions. Thus, the technology related to slotted bone tools in the area remains unclear.

5. Deposition

The blades and cores relating to the HCC are commonly found in private collections that were collected via field walking from within the focus area. It can be assumed that these surface finds come from unknown/unexcavated settlement sites. Only few sites containing handle cores or related blade production have been excavated in the area, Satrup LA 2 and Owschlag representing two of them.

As already mentioned, the preservation conditions for organic remains are poor in the area and few organic finds, such as slotted bone points, have been found. However, one slotted bone dagger was found in a grave from the Mesolithic burial site Groß Fredenwalde (dating to ca. 6500-6300 cal BCE), in Northeastern Germany. The dagger represents a grave good along with 17 blades/bladelets, 41 deer pendants and some bone awls (Terberger *et al.* 2015). This shows clear parallels to the Southern Scandinavian burials at Tågerup.

6.1.4.4 The *chaîne opératoire* in focus area 3 – Southeastern Norway

0. Acquisition of raw materials

In the focus area, a large variety of local raw materials was used alongside semi-local and exotic raw materials during the Mesolithic (Damlien 2010b). This is also reflected in the raw materials implemented on the sites included in this study. The varying amounts of flint tools and debitage from these sites can be seen in Table 83, and is somewhat related to the availability of flint in the local landscape. Stene terrasse, with the smallest amount of flint on site, is in an area where flint does not exist locally. The closest sources of (beach) flint is in the Oslofjord area and on the coastlines to the west and south (Högberg and Olausson 2007, 32-35; Damlien 2010c, 500, 502-3). The other sites are, however, located in those areas, which means that flints are available in the landscape for the remaining sites.

Interestingly, despite the varying amounts of flint on the sites in general, most of the recorded materials (mainly representing the handle core concept) are made from flint (Table 83). This could be an indicator that flint was prioritised to

Site	Amount of flint in assemblage	Amount of flint in recorded assemblage	Source
Lokalitet 3 (Halden project)	94.4%	100%	Melvold 2006, 31
Stokke/Polland 8	83%	100%	Fossum 2017, 439
Krøgenes D2	46%	100%	Mansrud *et al.* 2018, 288
Vallermyrene 4	28.7%	100%	Eigeland and Fossum 2014, 37
Stene terrasse	9.4%	96.3%	Damlien 2010b, 282

Table 83. Amount of flint in the lithic assemblage from each site compared to the amount of recorded flint.

produce blades in general, or specifically handle cores in this focus area. Only at Stene terrasse, which has the lowest amount of flint in general, do we find a small number of finds made from other raw materials (quartzite and jasper), although it should be noted that assemblages from two of the sites, Krøgenes D2 and Vallermyrene 4, contain significant amounts of remains from axe production, which produces a lot of debitage, and thus a dominance in the raw material percentages.

A large majority of cores from the focus area are made from nodules. The assemblages from Vallermyrene and Stene terrasse contain no handle cores made from flakes, while the remaining assemblages contain two cores each made from flakes. However, small numbers of available cores from Krøgenes D2, Stene terrasse, Stokke/Polland 8 and Vallermyrene 4 should be noted.

1. Core preparation phase

The first step in the preparation of a core is the creation of a platform, which is done here according to the Horoka method. This is clear from the lack of bifacial shaping of the core body, a wider cross section and the presence of remaining cortex on the sides and back of many cores (ranging from 27-40.7% of cores).

Except for one core from the largest assemblage in the focus area, all cores have a single platform (KSFA). After the creation of the platform, the core sides (KS1 and KS2) and back (KR) were prepared. This is commonly done through the removal of flakes from the sides using direct percussion as seen on 38-42% of the core sides in the focus area. Often, this attribute is combined with additional side edge preparation that is present on 35-40% of the core sides in the focus area. More rarely, core sides display cortex or one single flake negative. No clear regional patterns can be assumed due to the small number of cores from several of the sites within the focus area.

At this stage, the back of the cores was either left unprepared (displaying cortex) or prepared by removing flakes using direct percussion. The latter is most common in all assemblages from the focus area, except for Stokke/Polland 8 which has one core of each variety.

Prior to the start of blade production, the core front was prepared at one end of the elongated cores. One assemblage from the focus area (from Lokalitet 3) contains handle cores with more than one core front. Here, single cores had two independent core fronts and two opposing core fronts.

The preparation of the initial core front can be indicated through a look at the dorsal blade faces (DBF) from the sites. Most blades from each site display 2-3 dorsal blade faces indicating that they are produced during the main blade production phase. The presence of cortex or cresting on the dorsal part of the blade can indicate how the initial stages of blade production started. Cortex is found only on very small portions of the assemblages from Stokke/Polland 8 (1.2%) and Vallermyrene (0.7%), but cresting is not found on any of the blades. The lack of cresting on the blades indicated that the core front was prepared in some other way prior to blade production. The presence of some cortex could indicate that the core front was only partially prepared before blades were produced. Another option, although not investigated here, could be that the core front was prepared after the removal of a larger flake from the front of the core, similarly to the procedure carried out during blade production when the front is rejuvenated.

2. Main production phase

The presence of side edge preparation of the cores from the area (35-40% of cores, see also above) showed that it was common to remove sharp edges from the sides of the core. This could be done in oder to not cut one's hand (when hand-held) or to avoid breaking the edge during blade production (while in a holding device).

The attribute blade twisting (TWIST) in the focus area showed a slight majority of blades without twist, with 58.8% of blades having no twist and 41.2% of blades displaying twisting. This could indicate that most blades were detached in some sort of device that stabilises the core, although the difference is not significant enough to provide a strong basis for this interpretation. Alternatively, only a portion of the blades could have been produced using a holding device, or there was a variety of different holding devices available. Varying levels of knowledge and know-how might also affect these results. Further research on the mechanics behind twisting during blade production would be beneficial to understand the aspects that affect this attribute.

The blade production itself, and the techniques involved, can be interpreted from several attributes found on the blades and cores. As suggested by Damlien (2015), blade regularity, conus formation and interior platform angle are relevant indicators of knapping technique. Blades from the focus area are most commonly regular (62-75% of blades). However, the assemblages from Stene terrasse, Stokke/Polland 8 and Vallermyrene 4 also contain a large portion of irregular blades. The blades from Stene terrasse are generally more irregular than the other sites in F3, amounting to 31.3%, which could be due to the higher variety of raw materials at the site and/or more technological variety (presence of conical core concept, Damlien 2010c). The assemblage from Krøgenes D2 instead contained a higher amount of extremely regular blades compared to the other sites in F3.

Most blades from the focus area lack any form of conus formation. The blade assemblages from Vallermyrene, Stokke/Polland 8 and Krøgenes D2 all have over 90% of blades with no conus formation. The number is only somewhat lower at Stene terrasse, with 82.4%.

The four cores from Krøgenes D2 have IPAs ranging from 85-110 degrees. The two cores from Stene terrasse have angles from 90-95 degrees. The four cores at Stokke/Polland 8 have angles between 85-115 degrees. The four cores from Vallermyrene 4 have IPAs between 100-130 degrees. The only site with a larger number of cores is Lokalitet 3, Halden excavations, where the IPAs span between 80-120 degrees with most cores between 85-105 degrees (73.2%). In general, the high IPAs from the different sites indicate that pressure technique was used to detach blades, although indirect technique cannot be excluded. Moreover, it needs to be stated that these measurements are taken from already discarded cores and does therefore not perfectly reflect the angles used during the main blade production phase.

The curvature (CURV) of blades from the sites Krøgenes D2 and Vallermyrene 4 are almost equally divided between straight blades and evenly curved blades, which could indicate the equal use of softer (indirect/pressure technique) and harder (direct percussion) techniques. At Stene terrasse, straight blades are more common than evenly curved blades (50% and 40%, respectively), which could support the use of softer techniques. The opposite is seen in the assemblage from Stokke/Polland, where most blades have an even curvature (46.5%) followed by straight blades (30.2%), which could be indicative of a greater use of hard techniques than soft ones. Thus, if we assume that blade curvature relates to the hardness of the technique, there might be some regional variations within the focus area. More studies on the relationship between blade curvature and knapping techniques are nonetheless necessary to understand these patterns. Based on the already mentioned, statistically reliable knapping indicators (Damlien 2015), pressure or indirect techniques were likely used for blade production on these sites.

Prior to the removal of each blade, the core front was prepared by removing the overhang from the previous removal. This was done through trimming, abrasion or a combination of them. The remains of this action are seen both on the core front (PPCD) and on the proximal dorsal part of the blades (SFPD). Core front preparation was mainly done by means of trimming. Only very small amounts of blades showing abrasion, trimming and abrasion or no preparation were found in the assemblages. Most blades (62-80%) from each site were prepared by means of trimming. The amounts of the remaining attribute variations, however, differ between the different sites. At Krøgenes, trimming in combination with abrasion is also rather common (10%). At Stene terrasse, the blades are equally divided between the remaining attributes, while a very similar trend is apparent at Vallermyrene. At Stokke/Polland, blades commonly lack any preparation (31%). The common manner of overhang removal seems to have been by means of trimming, although the difference in the details could reflect individual or regional differences.

Core rejuvenation in the area is indicated by the platform morphology (PMORPH). Each site from the focus area contains handle cores with smooth platforms and with faceted platforms. In the focus area, there are more cores with smooth platforms (65.8%) than partly and fully faceted platforms (together 34.2%). This would indicate that most handle cores were rejuvenated by removing flakes from the front of the core, rather than by removing flakes from the platform. There are, however, some differences between the sites in the area. Krøgenes D2 has equal amounts of cores with smooth and faceted platforms, while Vallermyrene has one more core with a smooth platform compared to faceted platforms. At Lokalitet 3 and Stene terrasse, most cores are smooth, although Stene terrasse has a much smaller assemblage (3 cores). Stokke/Polland is the only site with more cores that have faceted platforms rather than smooth ones (4/5 cores are faceted).

A core rejuvenation strategy can also be confirmed through the finds of rejuvenation flakes, knapped from the core front or the core platform. From Lokalitet 3 and Vallermyrene 4, only frontal or side-frontal rejuvenation flakes are recorded, while Stokke/Polland only had platform rejuvenation flakes. No rejuvenation flakes were recorded for Krøgenes D2 or Stene terrasse. These patterns could indicate some local or regional variation of this attribute, but require further investigation.

3-4. Modification and use

The excavation reports list only a few examples of clear microliths or retouched blades, although most assemblages include many smaller blades (Damlien 2010b; Eigeland and Fossum 2014; Fossum 2017; Mansrud *et al.* 2018; Melvold 2006). Only the Stene terrasse assemblage contains a small amount of microblades, indicating that microblade production was not a significant activity on the site. On this site, two microliths were also found in the form of scalene triangles (Damlien 2010b, 283).

The remaining sites also contain only single finds of retouched blades. This would indicate that most handle core blades were used as blanks without further modifications within this focus area. Although thorough research has focused on the technological aspects of the handle core concept in (mainly eastern) parts of Norway (cf. Eigeland 2015), little focus has been given to the later stages of the *chaîne opératoire* relating to the concept. This includes how the blades were implemented after production, related technologies and activities. However, there is a general assumption that the blades were related to hunting practices, probably as inserts in composite tools. Fragments of slotted bone points support this idea and appear (although rarely) in the archaeological assemblages from the Mesolithic around the Oslofjord area (Glørstad 2010, 164). The production of slotted bone points is also assumed to correspond to the tradition as determined for Southern Scandinavia (Glørstad 2010, 165).

5. Deposition

All the assemblages from the focus area represent settlement sites with poor organic preservation conditions. It can nonetheless be assumed that these technologies were largely produced in the settlement sites, where they are also often deposited. Few Mesolithic graves, including flint finds, are known from Norway (cf. Schülke 2022), so any relation between handle cores, blades, composite tools and graves/burials is not known at this point.

6.1.4.5 The *chaîne opératoire* in focus area 4 – Southern Lithuania

Since the core data from F4 is scattered, represented by only single cores from various sites that lack chronological baselines, I will not suggest a coherent *chaîne opératoire* for the area.

6.2 Chronology of the concept

As a complement to the already available dates (listed in Appendix II), an effort was made to produce new reliable dates from contexts with clear contextual relationships to the handle core finds. However, only a few new dates could be produced due to lacking availability of organic remains from such contexts. Future excavations and dating efforts are necessary for an accessment of this type of information. Nonetheless, a few new dates were produced under the scope of this project from the two sites Stanovoye 4 (in F1) and Ljungaviken (in F2a). An unsuccessful attempt was also made to date organic samples from Satrup LA 2 (F2b).

The new dates are presented below and their relation to the previously dated samples will be discussed in detail in Chapter 7.

6.2.1 Dates from focus area 1

The sample information and resulting dates from the newly dated samples from Stanovoye 4 can be found in Table 84. These dates, along with the previous dates from the site (in Appendix II), suggest a long site chronology which has been investigated in detail (Söderlind and Zhilin 2021).

The four new dates from Stanovoye 4 largely support the previously suggested chronology of the site (cf. Zhilin 2002; 2009; Zhilin and Matiskainen 2003; Zaretskaya *et al.* 2005; Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021). The three dates from cultural layer IV, which is the oldest cultural layer of the site and related to the Butovo technocomplex, span between 9991 and 7961 cal BCE, although one sample (KIA-53780) is likely incorrectly documented and should rather belong to layer III. This adjusts the span, as based on the two remaining samples (KIA-53778 and KIA-53779), to between 9991 and 9242 cal BCE. However, along with the previously dated artefact samples from the layer, a chronology appears that suggests a longer chronology for the layer, between ca. 10,000 and 8600 cal BCE (Söderlind and Zhilin 2021). The material culture in this layer relates to the Butovo technocomplex and includes single-fronted blade cores.

The date from cultural layer III (KIA-53781) as well as the date with seemingly incorrect contextual information (KIA-53780) date to almost the exact same time, between 8297 and 7961 cal BCE, although, when seen alongside the dated samples from the context, the layer spans a much longer chronology, lasting from ca. 8800 to 7200 cal BCE. The finds from this layer are typologically and technologically interpreted as Middle Butovo technocomplex and the assemblage includes single-fronted cores.

Thus, single-fronted cores were found in two distinct layers at the Stanovoye 4 site, one spanning from 10,000-8600 cal BCE and another spanning from 8800-7200 cal BCE. The same layers also contain finds of conical cores related to the CCPC, indicating a joint existence for these concepts on the site.

6.2.2 Dates from focus area 2a

Sample information and dates relating to the new dates from the relevant context from Ljungaviken can be found in Table 85.

The two new samples were taken from a hearth within Hut 3, in which handle cores and small blades have been found. Previous dates and shoreline curves suggested a scattered chronology for the hut, ranging sometime

Table 84. Recent radiocarbon dates from Stanovoye 4 (after Söderlind and Zhilin 2021).

Sample ID	Site	Trench	Layer	Square (at depth, cm)	Material (Species)	Artefact	Radio-carbon Age	Calibrated dates (BCE) (95.4% range)
KIA-53778	Stanovoye 4	3	IV	157 (182)	antler (Elk)	socket	9855 ± 50 BP	9447-9242
KIA-53779	Stanovoye 4	3	IV	9 (180)	antler (Elk)	socket	10135 ± 55 BP	9991-9454
KIA-53780	Stanovoye 4	3	IV	165 (140)	bone, mandible (Beaver)	tool	8975 ± 50 BP	8289-7961
KIA-53781	Stanovoye 4	3	III	160 (168-172)	bone, mandible (Beaver)	tool	9005 ± 45 BP	8297-7973

Sample ID	Site	Context	Material (Species)	Radiocarbon Age	Calibrated dates (BCE) (95.4% range)
Poz-113764	Ljungaviken	Hearth in Hut 3	charcoal (Corylus)	7050±60	6058-5786
Poz-113765	Ljungaviken	Hearth in Hut 3	charcoal (Prunus spec.)	6860±50	5876-6540

Table 85. Recent radiocarbon dates from Ljungaviken.

between 6421 and 5639 cal BCE (Lagerås, in Kjällqvist and Friman 2017, 52). The additional dates support the younger end of that phase, focusing the chronology from ca. 6058-5639 cal BCE. This is further supported by the use of South Scandinavian flint for blade production in the hut, which is common for the later stages of the Mesolithic in the area (*ibid.*). The dating of this context, which includes handle cores and blades, places the use of handle cores in the area at this time, although these results must be seen as a reliable dating moment in time where the handle core concept was in use, rather than an indicator for a start or end of the use of the concept regionally or generally.

7 Discussion

The discussion will be structured based on the previously stated research questions. These relate to three broad themes, namely the technology of the handle core concept in Northern Europe (7.2), the chronology of the handle cores (7.3) and the transmission of knowledge in Mesolithic Northern Europe (7.4).

7.1 New insights into the HCC, chronology and knowledge transmission

The objective of this project was to investigate mobility, contacts and transmission of knowledge during the Mesolithic in Northern Europe. To understand the technological character of the handle core concept and to investigate any technological variation within Northern Europe, I will map the concept in my research area. The lithic data analyses demonstrate regional differences in relation to three core attributes: platform preparation (PMORPH), side preparation (KS_comb) and frontal preparation (PPCD). The cluster analysis of these attributes indicated a regional division, where most of the cores from Western Russia clustered with most cores from Southern Lithuania (in cluster 1). Cluster 2, in contrast, contained most of the cores from Southern Sweden, Northern Germany and Southeastern Norway. This shows that there are more technological similarities between the cores within Scandinavia/Northern Germany, while stronger similarities also exist between the assemblages from Western Russia and Southern Lithuania. The results of the correspondence analysis highlighted that Cluster 1 was characterised by faceted platforms (PMORPH-2), core sides with cortex (KS_comb-11) or cortex/simple preparation combinations (KS_comb-12, KS_comb-21) and frontal preparation involving trimming and/or abrasion on top of the platform (PPCD-4 and PPCD-5). Cluster 2 was more varied in character, but included a larger presence of smooth platforms (PMOPRH-1), core sides with lateral edge preparation (KS_comb-13, 23, 31-33) and frontal preparation characterised by trimming and abrasion (PPCD-1-3).

Although the blade data has a more homogenous character, some regional variations were suggested, relating to the presence of Wallner lines (WN), dorsal preparation (SFPD) and platform preservation (SFPE). This dataset is, however, limited to data from Scandinavia and Northern Germany and therefore does not reflect the whole research area. Nonetheless, the cluster analysis indicated that the different focus areas are rather similar in terms of these attributes but with slightly higher similarity between Southern Sweden and Northern Germany, than with Southern Norway. Focus area 2a seems to have rather strong associations to the attribute variations fine Wallner lines (WN-1), abrasion (SFPD-1) and a weaker association to smooth platforms (SFPE-2). Focus area 2b is rather weakly associated with the attribute variations broad Wallner lines (WN-2), abrasion and trimming (SFPD-3) and crushed platforms (SFPE-3). Lastly, focus area F3 seems to correspond strongly to the attribute variations no Wallner lines (WN-0), no platform preparations (SFPD-0) and trimming (SFPD-2) as well as faceted platforms (SFPE 57).

7.2 The handle core *vs.* the single-fronted core

The term “handle core” was already coined within a Scandinavian research arena in the late 19th century. The concept has thus been thoroughly researched in Scandinavia for more than a hundred years, resulting in substantial data and discussions regarding definitions, technology and chronology (cf. Chapter 2). Consequentially, the definitions of the handle core concept (HCC) are largely based on these materials within a Scandinavian research history. Although, the presence of the concept beyond Scandinavia has been previously suggested (*e.g.* Olofsson 1995; 2003), it has not been investigated on a pan-European, comparative scale until now. The results of my technological analyses indicate technological similarities as well as differences between this type of core and blade production in Northern Europe, which will be discussed in detail in this chapter.

First, a note should be made regarding the terms “handle core” and “single-fronted core”. I use the latter term in a broader sense to refer to the morphology of the core, with its single knapping front located on one side of the core (although on occasion there are two of them on opposite sides of the core). It is a similar term to “wedge-shaped core” or “keeled core” in that it is a term for a core of a certain shape. This core morphology and the manner of blade production appear in various blade production concepts throughout prehistory and are thus not unique for the blade concepts discussed in this study. For instance, the late Aurignacian *burin des Vachons* fits this morphological definition as well (Fig. 158). This Aurignacian tool has been interpreted as either a burin, a bladelet core and/or a shafted point (Arrighi *et al.* 2006; Pesesse and Michel 2006; Dinnis *et al.* 2009). Single-fronted cores have also been found in Scotland and are interpreted as a local strategy for core reduction based on the elongated shape of the flint nodules

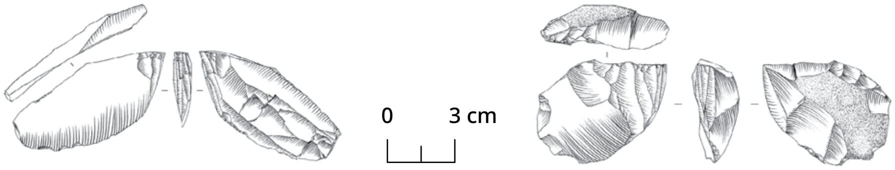


Figure 158. A Late Aurignacian "Burin des Vachons" tool (after Pesesse and Michel 2006).

in the area although no drawings or photographs of these finds have been published (Ballin and Barrowman 2015).

The term "single-fronted core" is thus a general term for cores with a single knapping front. In the following chapter, I will use this term to refer to the cores found in Western Russia and Lithuania, for two reasons. Firstly, they fit the morphological description in that they are single-fronted cores, and secondly since the more specific details regarding their related technological concept(s) are not yet well-understood. In this study, I have begun to explore the single-fronted cores east of the Baltic, but the number of finds and a lack of dates (especially for Lithuania) limit the results presented here. More studies and, more importantly, more available data are needed to understand the specific characteristics of these core concepts. This research status stands in strong contrast to the Scandinavian/Northern German cores, which are also single-fronted, but have been studied in detail for more than 100 years, and have a specific set of characteristics that single them out as a specific variety of the single-fronted core, with a related technological concept, more specifically known as the "handle core concept". Therefore, I use the term "single-fronted cores" to refer to the Russian/Lithuanian cores or the core type in general and "handle core" to specifically refer to the Scandinavian/Northern German cores.

7.2.1 Single-fronted cores in different parts of Northern Europe

Although features, such as core morphology and placement of the core front, are similar across the whole research area, several technological features vary. As will be shown, the diffusion of the HCC can be indicated on a large spatial scale (across Northern Europe) and on a medium spatial scale (within Scandinavia and Northern Germany). However, for a more small-scale (regional) understanding of the concept, more substantial and finely resolved data from each focus area is needed.

7.2.1.1 Large-scale variation of the handle core concept (all focus areas)

Raw material availability and use

Differences between the different focus areas are found in the variation of raw material availability across Northern Europe. These differences relate to core size, blade size and size of blade butts. The results show that the larger cores and blades come from areas with larger quantities of good quality flint, specifically in Southern Scandinavia and Northern Germany. A similar result was found by Olofsson (Olofsson 1995, 108-109; 2003), who concluded that handle cores from Southern Scandinavia, where flint is abundant, are generally larger than cores from Northern Sweden where other local raw materials were used instead of flint. Interestingly, the recorded cores and blades of the assemblages from Northern Germany are larger than the cores and blades from Southern Scandinavia. While the primary outcrops in Northern Germany are few, it can be assumed that most nodules were sourced from beaches or deposits in the moraine soil. Based on the large core and blade sizes from the sites in focus area 2b, these secondary sources must have contained large nodules suitable for knapping. Furthermore, most cores from Northern Germany represent surface collection finds, which explains the larger core sizes as well, since they are more easily recognisable during field walking than smaller finds. The cores from Western Russia and Norway are smaller than those from the other areas. In Western Russia, the locally available flint sources are of poor quality and provide only small nodules, which helps to explain this pattern (Zhilin 1997). In Norway, the smaller cores can likely be explained by the presence of locally available beach nodules (regionally) along with the more general use of local raw materials other than flint (*e.g.* Damlien 2010b).

Within the research area, it seems that the presence of single-fronted cores largely correlates to the presence of available flint sources. In fact, the southernmost distribution of this core type corresponds very closely to the southernmost distribution of Scandinavian flint, as transported by the Weichselian ice sheet (Söderlind *et al.* 2023). A similar pattern is seen in Lithuania, where the single-fronted cores are found in the same area as the available flint sources (Šatavičius 2016). In the northeastern part of the research area, in the Upper Volga region, single-fronted cores and related blade production is mainly related to the use of local flints (Zhilin 1997). This indicates a strong relationship between the handle core concept/single-fronted cores and flint as a raw material in large parts of the research area. However, the northwestern parts of the research area diverge from these patterns. Here, in Central and Northern Scandinavia, the HCC is established despite the complete lack of locally available flint. Instead, handle cores are commonly produced from various local raw materials, for instance, quartz, quartzites and porphyries (Olofsson 1995). Although the HCC can be implemented using other materials than flint, as exemplified by the Norwegian materials (as well as assemblages from Northern Sweden), its distribution pattern in the southernmost areas may indicate that it somewhat follows the distribution area for Scandinavian flint. This is supported by the fact that the handle core concept does not seem to have been used in areas south of the Scandinavian flint border (which goes through Northern Germany), despite the presence of other knappable materials (cf. Mester *et al.* 2012; Gehlen *et al.* 2021; Flintsource.net).

There are several other parts of Northern Europe, where these single-fronted cores do not seem to have been implemented at all, based on the absence of finds. These areas include Finland, Estonia, Latvia and most of Northern Poland. In Northern Poland, flint is available in smaller nodules. Further south, *i.e.* Greater Poland, high-quality flint was available and commonly traded with areas further north during the later Mesolithic (Masojć 2016). Assuming that that the availability of flint is related to the implementation of the HCC in these southernmost parts of the research area, it does not seem that the knowledge and know-how related to the concept diffused to these areas, or it did not catch on in the societies in the area. This is an indicator that the raw material availability was not the sole premise for the diffusion of knowledge relating to the use of this core type. Rather, other social factors likely played a role in these patterns as well. It is possible that the area of modern Poland is located in a corridor where single-fronted elongated cores were never actually introduced, potentially due to its location between two centres of innovation, as will be discussed further below.

Technological differences across the research area

The technological analyses from the research area indicate stronger similarities between focus areas 2a, 2b and 3 as well as between focus areas 1 and 4. One difference between the two areas, west and east of the Baltic Sea, is found relating to the front preparation (PPCD) of the cores. In focus areas 1 and 4, parts of the core assemblages display trimming and/or abrasion on top of the platform, directly at the blade front. This is sometimes recorded in combination with "regular" frontal preparation located on the front of the core. This attribute, or attribute placement, is not seen anywhere else in Northern Europe, and could thus be an indicator of regionality and stronger social contacts between these areas, compared to other parts of the research area.

Another difference between cores east and west of the Baltic Sea relates to platform morphology (PMORPH). Although cores with faceted platforms and smooth platforms appear in all focus areas, most of the cores from F1 and F4 have faceted platforms, while most of the cores from F2a, F2b and F3 have smooth platforms. Especially focus area 2b has a large majority of cores with smooth platforms, while F2a and F3 have near equal proportions of the two platform morphologies. The manner of platform preparation is chosen by the knapper based on preference, habit and tradition and does not affect the blade production process in any significant way (Sørensen *et al.* 2013). Therefore, the observed variation related to platform morphology within the research area should reflect said aspects, rather than external factors.

Another difference is seen in the preparation of the core sides (KS). There are higher amounts of remaining cortex on the cores from focus areas 1 and 4 compared to the other areas. Cores from these areas also display significantly lower amounts of lateral edge preparation than the areas west of the Baltic. The lack of lateral side preparation in the Upper Volga region could be explained by maintaining as much of the already small nodules available in the area as possible. This, however, does not explain the same pattern in Southern Lithuania, which is an area characterised by locally available good-quality flints. Instead, the lower amounts of lateral edge preparation on these cores are more likely to reflect a technological difference in the manner of blade production from single-fronted cores in these areas. Possibly, this relates to a difference in how the core is held during blade production.

To conclude, the cores from focus areas 1 and 4 are characterised by a different type of front preparation which is located on top of the platform by the front. Most of the cores were also prepared with faceted platforms. The core sides are less prepared, as seen by larger amounts of remaining cortex as well as a lesser amount of lateral edge preparation. Cores from focus areas 2a, 2b and 3 are instead characterised by a higher degree of trimming and/or abrasion on the core front and no trimming on top of the core platform. Additionally, a higher proportion of cores have smooth platforms, although faceted platforms are also not uncommon. The core sides commonly display careful preparation, as seen by the removal of flakes as well as by the presence of lateral edge preparation. Since these lateral edge preparations are likely related to the manner in which the core is attached in a holding device (cf. Callahan 1985; Sørensen 2001; 2003; 2006), the difference between the focus areas may represent a variation in how the core was held during blade production. It is, however, not clear if the cores from focus areas 1 and 4 were held in another type of device or if they were hand-held. Future use wear studies of the sides of cores from these areas could possibly answer this question. The lateral edge preparation on the cores from focus areas 2a, 2b and 3 is assumed to represent an attachment in a clamp-like device, as suggested by previous use wear studies (Sørensen 2001; 2003). These patterns may also be affected by a difference in available data from each focus area, with more data available from focus areas 2a, 2b and 3 than focus areas 1 and 4. Furthermore, focus area 1 is represented by only one site, which shows the need for further research into these results, especially in the eastern parts of the research area.

The differences between the materials east and west of the Baltic Sea are reflected by a variety of factors, including variation in knapping methods/techniques for blade production and varying raw material availabilities. This would indicate that the social traditions relating to the production of blades from single-fronted cores were different in the eastern and western parts of the research area. This could relate to two separate social spheres in Northern Europe during the later part of the Mesolithic. Furthermore, this would imply a shift from very large-scale mobility and contacts during the Early Mesolithic (as exemplified by the diffusion of the CCPC), to more regional scales in the Late Mesolithic (as exemplified by the diffusion of the HCC).

7.2.2 Medium-scale variation (F2a, F2b and F3)

Frontal preparation – cores and blades compared

In focus areas 2a, 2b and 3, trimming is by far the most common type of core front. Abrasion or abrasion and trimming is common only in focus area 2a, which could reflect a regional tradition in core preparation. However, this is also the focus area with the largest number of cores, which increases the chance for sample size effect (Grayson 1981). The same attribute has also been observed on the blades (SFPD). Interestingly, the blade assemblages show higher proportions of finds with a combination of trimming and abrasion (Table 86).

There are several possible reasons for these patterns. For instance, the lower amounts of preparation on the core fronts could be a result of the knapper only preparing the core front immediately before detaching a blade. This would result in said preparation mainly being found on the proximal blade ends rather than the core fronts. However, it is more likely that these patterns reflect local or regional variation within the focus areas due to the uneven recording of cores and blades from the different sites. As seen in the table below, the cores from F2a

Table 86. Amounts of trimming and/or abrasion on cores and blades in datasets from each focus area.

	Cores (PPCD)	Sites (no. of finds)	Blades (SFPD)	Sites (no. of finds)
F2a	29.3%	Tågerup (117) Rönneholm 6 (21) Ljungaviken (12)	35.2%	Rönneholm 6 (428) Tågerup (191) Ljungaviken (120)
F2b	5.1%	Dreggers LA 3 (53) Satrup LA 2 (5) Owschlag LA 183 (1)	46.6%	Satrup LA 2 (305)
F3	1.6%	Lokalitet 3 (46) Krøgenes D2 (6) Vallermyrene 4 (6) Stokke/Polland 8 (4) Stene ter. (2)	8.6%	Vallermyrene 4(268) Stokke/Polland 8 (58) Krøgenes D2 (40) Stene ter. (16)

mainly come from the Tågerup site, while the blades mainly come from Rönneholm. In the same way, the cores from F2b are mainly represented by Dreggers LA 3 while the blades all come from Satrup LA 2. The cores from F3 mainly come from Lokalitet 3, while the blades mainly come from Vallermyrene 4. These varying sample sizes likely play a role in these apparent core-blade variations.

Platform preparation – cores and blades compared

Although the majority of cores and blades in each focus area have smooth platforms, there are varying amounts of cores and blades with faceted platforms, which indicate regional variability, as has been confirmed for the earlier Conical Core Pressure Concept (CCPC) (Damlien *et al.* 2018; Sørensen 2018; Kjällquist 2020). The data from the focus areas shows the highest percentage of faceted/partly faceted platforms in F2a, followed by F3, while the smallest amount is found in F2b. The same attribute has also been observed on the blades (SFPE), which have lower percentages of finds with remains of faceting (Table 87).

Similar to the presence of trimming/abrasion discussed above, the differences in platform preparation on cores and blades likely reflects varying sample sizes from different focus areas. The cores from F2a mainly come from Tågerup, while the blades largely come from Rönneholm 6. In the same way, the cores from F2b mainly come from Dreggers LA 3, while the blades are represented by Satrup LA 2. The cores from F3 are mainly from Lokalitet 3, while the blades are largely represented by Vallermyrene 4. The lower degree of faceting of the blades compared to the cores could also relate to the fact that individual blade platforms are smaller and do not always display clear indications of coming from a faceted core. The general variation in platform preparation could also reflect regional variations of cultural traditions, similar to the CCPC (Damlien *et al.* 2018; Sørensen 2018; Kjällquist 2020). This may also have implications for the HCC, as the data indicates potential small-scale variations. Further regional studies will however be needed to investigate these patterns.

Variations in blade production

The blades from focus areas 2a, 2b and 3 are generally similar, which indicates that blade production from handle cores is similar in these areas. Some differences do exist, for instance, relating to some variation in the presence of Wallner lines (WN). More pronounced Wallner lines on blades from F2b may indicate the use of harder techniques (possibly indirect technique). In contrast, the blades

Table 87. Amounts of faceted platforms on cores and blades in datasets from each focus area.

	Cores (PMORPH)	Sites (no. of finds)	Blades (SFPE)	Sites (no. of finds)
F2a	45%	Tågerup (127) Rönneholm 6 (23) Ljungaviken (10)	3.4%	Rönneholm 6 (429) Tågerup (189) Ljungaviken (115)
F2b	15%	Dreggers LA 3 (53) Satrup LA 2 (6) Owschlag LA 183 (1)	10%	Satrup LA 2 (298)
F3	34.2%	Lokalitet 3 (50) Vallermyrene 4 (9) Krøgenes D2 (6) Stokke/Polland 8 (5) Stene ter. (3)	26.3%	Vallermyrene 4 (260) Stokke/Polland 8 (57) Krøgenes D2 (40) Stene ter. (15)

from F3 commonly lack Wallner lines, which may be a result of more stable and softer techniques. The blades from F2a commonly show fine Wallner lines. These variations indicate a difference in the blade production strategies between the areas, with more or less stability or harder or softer knapping techniques. However, these differences could also relate to the use of different raw materials. Furthermore, a higher number of straight and distally curved blades in F3 may support the notion of blade production using soft (pressure) techniques from stable cores in the area. This is also supported by a very low presence of blades that terminate in feathering, plunging or hinging. Most recorded blades, however, lack distal ends, which could affect these results. Possibly, these patterns may suggest that the recorded blade assemblages are intermixed with blades made using the conical core pressure concept, which is characterised by extreme blade regularity and straightness.

The multivariate analyses have shown that the blades from F2a have stronger technological similarities to F3 than to F2b, which would indicate that the blade production in this area also is characterised by regularity, less pronounced/fine Wallner lines and complete platforms, all of which are indicative of the use of pressure technique. The analysis of the blades from F2b also indicates the use of pressure technique, based on blade regularity (REG) and a lack of conus formation (KE). However, a higher proportion of crushed platforms in this assemblage may indicate an intermix of harder techniques or lacking knowledge/know-how. The presence of regular blades and a lack of conus formation also support the use of pressure technique in focus areas 2a and 3.

7.2.3 A new definition for the handle core concept?

The stronger technological similarities between focus areas 1 and 4 as well as between 2a, 2b and 3 indicate that the materials from these two larger areas involve two separate technological concepts, centred west and east of the Baltic Sea. The additional difference concerning when the concepts were used in the two areas support the notion of them as two separate concepts, as will be discussed below.

A joint feature for both concepts relates to the morphology of the core as “single-fronted cores” that are initially elongated and have a blade production front placed at one narrow end. The concepts relating to the single-fronted cores east and west of the Baltic Sea during the Mesolithic are, nonetheless, characterised by different technological features. The technological variations will be presented here as the “model” for the western (Scandinavian/Northern German) handle cores and the “model” for the eastern Baltic (Upper Volga/Southern Lithuanian) single-fronted cores. It is, however, important to note that there are overlaps/grey zones between these attributes in the different areas, as will be discussed in detail after the presentation of the models.

The model of the cores from focus areas 1 and 4 can be described as having an elongated form with a single knapping front. The platforms of the cores are commonly faceted. Although the cores often have sides that are prepared through the removal of flakes, they lack any additional preparation of the lateral edge. The presence of remaining cortex on the core sides also shows a lower degree of general core side preparation. Additionally, these cores show a type of frontal preparation that is not found in other parts of the research area. This preparation, or frontal trimming, is located on top of the platform at the front. Since blades and flakes were not studied from these areas, little can be said about the specifics relating to blade production, such as the use of knapping techniques and core rejuvenation. Therefore, it is also difficult to compare these strategies to other parts of the research area. However, previous studies have suggested that the use of pressure technique was used for blade production from these cores in the Upper Volga area, based on the regularity of blank negatives on the cores and the finds of regular blades from Stanovoye 4 (*e.g.* Zhilin 2009; Hartz *et al.* 2010). However, the general shape of the single-fronted cores has also been presented as an indicator of pressure technique (Hartz *et al.* 2010, 164), which is a circular argument and can thus not be used as an argument for the use of pressure technique. Furthermore, several of the blade blanks that are shown as indicative of pressure technique are larger, extremely regular blades that cannot come from the smaller single-fronted cores that are discussed here.

The model for the cores from focus areas 2a, 2b and 3 is also characterised by the presence of an elongated form with a single blade production front. However, in these areas, the core platforms are generally smooth, although in certain assemblages most cores have faceted platforms. Possibly, some local/regional traditions or chronological variation could affect these patterns within Scandinavia. Furthermore, the cores from these areas commonly have carefully prepared core sides, both through the removal of flakes as well as through lateral edge preparation. The blades from these areas indicate the use of pressure technique. The rejuvenation flakes found in the studied assemblages indicate that cores were rejuvenated through the production of frontal rejuvenation flakes or platform rejuvenation flakes.

These models provide an overview of the technological variation in the different parts of the research area. However, it is important to note that the variations represent the "dominating" characteristics of that area and that smaller numbers of finds are found in other focus areas. This is true for both platform faceting (which is found in higher degrees in focus areas 1 and 4) and the presence of lateral edge preparation (which is found in higher degrees in focus areas 2a, 2b and 3). However, the presence of trimming on top of the platform, by the front, which is seen on cores from focus areas 1 and 4, has not been recorded on any cores from focus areas 2a, 2b or 3, making it unique on the eastern side of the Baltic Sea. However, other types of front preparation (regular trimming/abrasion) have also been found on cores in focus areas 1 and 4, not exclusively in areas 2a, 2b and 3. These technological variations that characterise the materials are thus dynamic, although some trends can be seen (as highlighted by the "models") for the different parts of the research area. The definitions of the handle core concept in Scandinavia or the single-fronted core concept in focus areas 1 and 4 must therefore be considered highly dynamic, and not easily definable. The "models" described above are nonetheless as close to definitions as possible at this point in light of the currently available data.

The materials from east and west of the Baltic Sea are generally similar, but include some technological variations, and could thus be argued to be related, or to represent regional variations of the same overarching technology. However, I will argue that the possible variations in blade production technique, core holding strategy and method of rejuvenation, along with the different chronologies relating to these materials (as presented in the following Chapter 7.3), suggest that they represent different technological traditions.

7.3 Chronology of the handle core concept

To generate an absolute chronology for the handle core concept in the research area, available dates from Mesolithic handle core/single-fronted core sites were collected, alongside information regarding sample materials, context and dating methods (all data used in this chapter can be found in Appendix II). Note that these dates do not include any dates from any Neolithic contexts, which will be discussed in Chapter 7.3.6. The cores and blades included in these models have not been studied in detail (except for the sites listed in Table 33). The information regarding dates and samples was used to evaluate them based on their contextual relationship with relevant finds (CE) and their overall sample reliability (SE) as described in Chapter 4.3. The two evaluation systems resulted in two ratings for each date, which were subsequently used to group the dates in four reliability levels, with level 4 being the most reliable. The chronologies resulting from these four levels are discussed below.

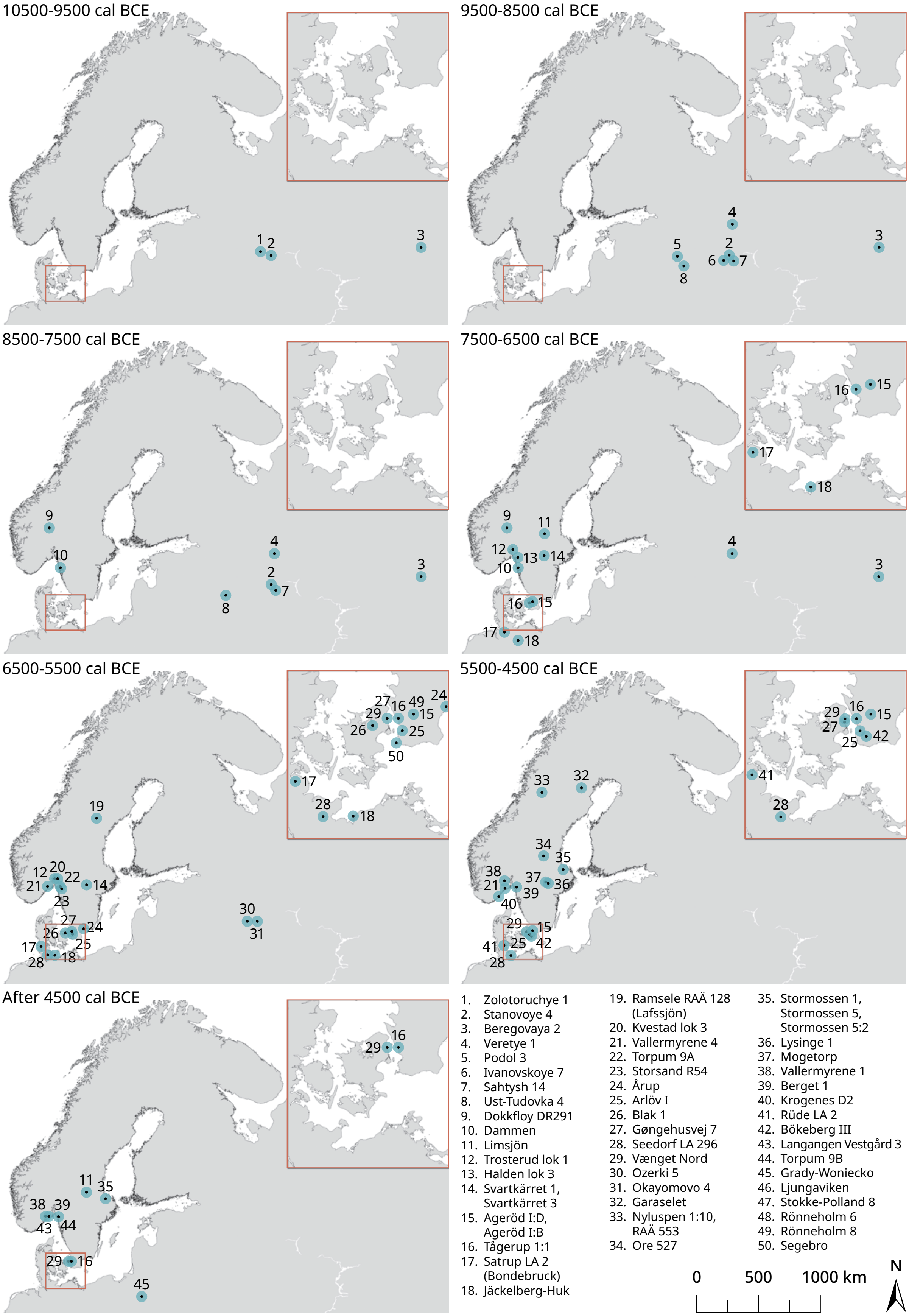
7.3.1 Reliability level 1

This level includes all the available dates (SE 0-10) from all contexts (CE 1-4). A total of 345 dates are included in the modelling (Fig. 159, data in Appendix II).

The dates indicate that the chronology, relating to handle cores/single-fronted cores, starts at around 10,500 cal BCE. The chronology then appears to continue in a rather stable rate until ca. 6800 BCE, when many more dates appear within the research area. After a sudden increase in dates, which lasts until ca. 6000 BCE, the number of dates again declines with only minor surges until ca. 3800 BCE, when there are no more dates (Fig. 163). However, the inclusion of samples and dates with low sample and context evaluation ratings makes this chronology largely unreliable and should therefore only be used to generate a basic chronological overview of the spread of the handle core concept.

According to this chronology, some regional chronological observations can be made. For instance, most dates that predate 7500 cal BCE come from Western Russia. The presence of single-fronted cores within the Butovo technocomplex has been previously established (Averin and Zhilin 2001; Zhilin 2002; 2007; 2009; Zhilin and Matiskainen 2003) and the dates collected under the scope of this project confirm these patterns. The oldest dates come from the sites Beregovaya 2 (GIN-14208: 10511-9452 cal BCE), located in the Ural region, and Zolotoruchye 1 (KIA-39314: 10469-9810 cal BCE), soon followed by Stanovoye 4 (KIA-53779: 9991-9454 cal BCE) which are both located in the Upper Volga region. These three sites, furthermore, dominate the earliest stage of the chronology, between 10500 and ca. 9300 cal BCE. Between 9300-9000, the single-fronted cores appear on sites such as Ivanovskoye 7, Veretye 1 and Sahtysh 14. All the mentioned sites have long site chronologies lasting until 7500 cal BCE. The chronology in Western Russia is also supported by dates from sites Ust-Tudovka 4 and Podol 3 from 8700-8400 cal BCE. A diffusion process cannot be clearly observed based on these dates and sites, however, a tendency of older dates from sites in the northeast (Beregovaya 2, Zolotoruchye 1 and Stanovoye 4) might contrast with some younger dates in the southwest (Ust-tudovka 4 and Podol 3). However, more dates and more reliable dates are needed for a reliable diffusion process, specifically from Neolithic contexts in these areas (cf. Chapter 7.3.6).

Figure 159 (opposite page). Sites represented within time intervals of 1000 years, according to reliability level 1.



1. Zolotoruchye 1
2. Stanovoye 4
3. Beregovaya 2
4. Veretye 1
5. Podol 3
6. Ivanovskoye 7
7. Sahtysh 14
8. Ust-Tudovka 4
9. Dokkfloy DR291
10. Dammen
11. Limsjön
12. Trosterud lok 1
13. Halden lok 3
14. Svartkärret 1, Svartkärret 3
15. Ageröd I:D, Ageröd I:B
16. Tågerup 1:1
17. Satrup LA 2 (Bondebruck)
18. Jäckelberg-Huk
19. Ramsele RAÄ 128 (Lafssjön)
20. Kvestad lok 3
21. Vallermyrene 4
22. Torpum 9A
23. Storsand R54
24. Årup
25. Arlöv I
26. Blak 1
27. Gøngehusvej 7
28. Seedorf LA 296
29. Vænget Nord
30. Ozerki 5
31. Okayomovo 4
32. Garaselet
33. Nyluspen 1:10, RAÄ 553
34. Ore 527
35. Stormossen 1, Stormossen 5, Stormossen 5:2
36. Lysinge 1
37. Mogetorp
38. Vallermyrene 1
39. Berget 1
40. Krogenes D2
41. Rüde LA 2
42. Bökeberg III
43. Langangen Vestgård 3
44. Torpum 9B
45. Grady-Woniecko
46. Ljungaviken
47. Stokke-Polland 8
48. Rönneholm 6
49. Rönneholm 8
50. Segebro

Between 7500-6500 cal BCE, Western Russia is still represented by a smaller number of dates (mainly from the site Ozerki 5), however, most of the dates that fall soon after 7500 cal BCE come from focus area 2a. The oldest dates come from the sites Tågerup (Ua-25206: 7340-6698 cal BCE), Dammen (Ua-5438: 7316-6695 cal BCE) and Ageröd I:B/I:D (Lu-599: 7175-6654; Lu-873: 7133-6652; Lu-698: 7058-6650; Lu-751: 7054-6644). These site chronologies also continue in the following centuries. Between 7000-6500 cal BCE, more sites are represented, including Lokalitet 3 (Halden excavations) and Trosterud Lok 1 in focus area 3. From focus area 2b, the sites Jäckelberg-Huk and Satrup LA 2 are included. In more northern parts of Sweden, handle core sites such as Svartkärret 1 and 3, and Limsjön date to this time.

The chronology thus indicates that the oldest single-fronted cores can be found in Western Russia, represented by Butovo-related technologies that include such cores. The later phase of dates relating to the Scandinavian handle cores in focus areas 2a, 2b and 3 would suggest a spread of this technology in that direction. However, such a diffusion process, with gradually younger dates towards the west, is not visible in the chronology. Instead, it is apparent that the oldest dates are limited to the eastern part of the research area, and rather suddenly later appear in F2a. Furthermore, a rapid diffusion from focus area 2a to adjacent areas (F3 and F2b) and beyond is indicated. If the technological differences between focus area 1 (and 4) and 2a, 2b and 3 are considered alongside the chronological pattern as shown by this dataset, they appear to represent two separate technological concepts:

- An older concept, related to the single-fronted cores in Western Russia.
- A younger concept related to the handle cores in Scandinavia/ Northern Germany.

7.3.2 Reliability level 2

This level includes dates with sample evaluation (SE) 4-10, from very good, good and ok contexts (CE 1-3). A total of 58 dates are included (Fig. 160). This reliability level is thus more reliable, both in terms of sample reliability and the contextual relationship between the handle core finds and dated samples. The significant reduction of dates/samples compared to the previous level indicates the problematic nature of the handle core/single-fronted core chronology in general as only a limited number of dates can somewhat reliably be connected with the lithic artefacts.

According to the chronology, two main phases are indicated, separated by a temporal hiatus (Fig. 163). The first phase, which lasts from ca. 10,500 to 7200 BCE, is only represented by dates from Western Russia (sites Zolotoruchye 1, Stanovoye 4 and Beregovaya 2). The second phase, which lasts from ca. 6500 to 4600 BCE, is instead represented by dates from focus areas 2a and 3. No dates from F2b are represented on this level. A single date from Lokalitet 3 (Halden excavations) falls between the two phases.

Figure 160 (opposite page). Sites represented within time intervals of 1000 or 500 years, according to reliability level 2. For a list of the sites represented in the map, please see figures 159, 161 and 162. Notice that there is a gap between 7000 and 6500 cal BCE due to a lack of sites represented within this time period. Sites represented within time intervals of various lengths, according to reliability level 3. Notice that there is a gap between 7500 and 6500 cal BCE, as well as between 5000 and 4500 cal BCE due to a lack of sites represented within these time periods.

10500-9500 cal BCE

9500-8500 cal BCE

8500-7500 cal BCE

7500-7000 cal BCE

6500-6000 cal BCE

6000-5500 cal BCE

5500-5000 cal BCE

After 4500 cal BCE

A more detailed look at the dates from the second phase provides indications for a regional diffusion process. The earliest dates come from focus area 2a, specifically the sites Tågerup (Ua-9946: 6475-6104 cal BCE) and Ljungaviken (LuS-12278: 6421-6092 cal BCE; Poz-113764: 6058-5786 cal BCE) and soon after from Rönneholm 6 (LuA-4921: 5990-5643 cal BCE; LuA-4914: 5971-5616 cal BCE; LuA-4915: 5727-5376 cal BCE). This is followed by dates from F3, specifically from the sites Torpum 9B (nine dates spanning 5622-4939 cal BCE), Stokke/Polland 8 (Ua-51840: 5302-5047 cal BCE) and Vallermyrene 4 (Ua-45172: 5299-5030 cal BCE; Ua-45171: 5205-4841 cal BCE). An additional site in Scania (Bökeberg III) and a site in Northern Sweden (Garaselet) also fall within this phase. Finally, one date from focus area 3 and the site Berget 1 date to 4238-3798 cal BCE (Tua-3225), much later than the remaining dates.

From this second phase of the chronology, a diffusion process for Scandinavian materials is suggested. The oldest dates from focus area 2a suggest an origin in that area, followed shortly by the presence of the concept in focus area 3. The presence of the dates from Garaselet indicates that the concept also spreads northward at the same time. This diffusion is based on dates from only a few sites within Scandinavia and needs more data to be supported in future studies. The chronology of the concept in focus area 1 is represented by only three sites.

The presence of handle cores in Southern Scandinavia (specifically Swedish Scania and Danish Zealand) around 6400 cal BCE and soon after generally support the previous chronological discussions (*e.g.* Becker 1953; Bille Henriksen 1976; Larsson 1978; 1983; Andersen 1984; Vang Petersen 1984; 2014; Sørensen 2001; 2006), which state that the handle cores came into use during the final phase of the Maglemose period (which ends at around 6500 cal BCE) or during the start of the subsequent Kongemose period (based on the chronology in Sørensen 2017, 18). The theory by Andersen (1984) that handle cores originate somewhere in Scania/Zealand is also supported, although the theory can now be supported by the presence of radiocarbon dates. This also means that the idea by Welinder (1973; 1974), which assumes that the handle cores appear simultaneously in Scania and on the Swedish west coast, cannot be supported in this study, although the diffusion of the concept is rather rapid which could mean a fast spread to the west coast of Sweden. The speed of the diffusion in Southern Scandinavia can be compared to the speed of the "Neolithic expansion" through Europe (Isern *et al.* 2017) which took place at an average rate of 1 km per year. If the distance between Southern Scania and Southeastern Norway is used (ca. 600 km), and the time used for the diffusion is set to ca. 500 years (according to this reliability level), this would mean that the diffusion speed is roughly 1.2 km per year. Although the diffusion related to the Neolithic expansion covers more area, includes more dates and is also considered to be mainly a demic diffusion, I argue that these parallels can be used to argue that the diffusion of the HCC in Southern Scandinavia was rapid.

However, the seemingly rapid diffusion of the concept towards Southern and Eastern Norway may also mean that the concept had spread very quickly to the Swedish west coast. Another possibility is that these patterns are a result of lacking reliable dates from the Swedish west coast. Furthermore, the presence of handle cores in Southern and Eastern Norway around 5600 cal BCE support the most recent chronology for the area (as suggested by Reitan 2016).

The hiatus between the dates from Western Russia and Scandinavia also support the idea of an independent invention/development of the handle core concept within Southern Scandinavia. The chronological hiatus that is related to the cores in the two areas, according to this reliability level, seems to last for ca. 700 years, which rather indicates that the cores relate to two different technologies, used at different times.

7.3.3 Reliability level 3

This level includes dates with sample evaluation (SE 7-10) from very good, good and ok contexts (CE 1-3). A total of 49 dates are included (Fig. 161). This chronology thus includes dates with the same level of contextual reliability as the previous level, but with a focus on more reliable samples.

Like the patterns seen for the previous level, the dates included in this reliability level also fall within two phases (Fig. 163), one that ranges between 10,500 and 7200 cal BCE (same as above) and another that spans 6400-4900 cal BCE, represented by sites from F2a and F3.

The first stage of the second phase, specifically ca. 6400-5200 cal BCE, is represented by dates from focus area 2a (sites Ljungaviken, Rönneholm 6 and Tågerup). In the later stages of this phase, specifically ca. 5600-4900 cal BCE, focus area 3 is instead represented (sites Torpum 9B, Stokke-Polland 8 and Vallermyrene 4). This pattern follows the diffusion process suggested by the previous reliability level. Finally, one date from focus area 3 and the site Berget 1 date to 4238-3798 cal BCE (Tua-3225). The much younger age of this sample could imply that it is an outlier. But previous studies support the age as the final stage of the usage phase (Reitan 2016).

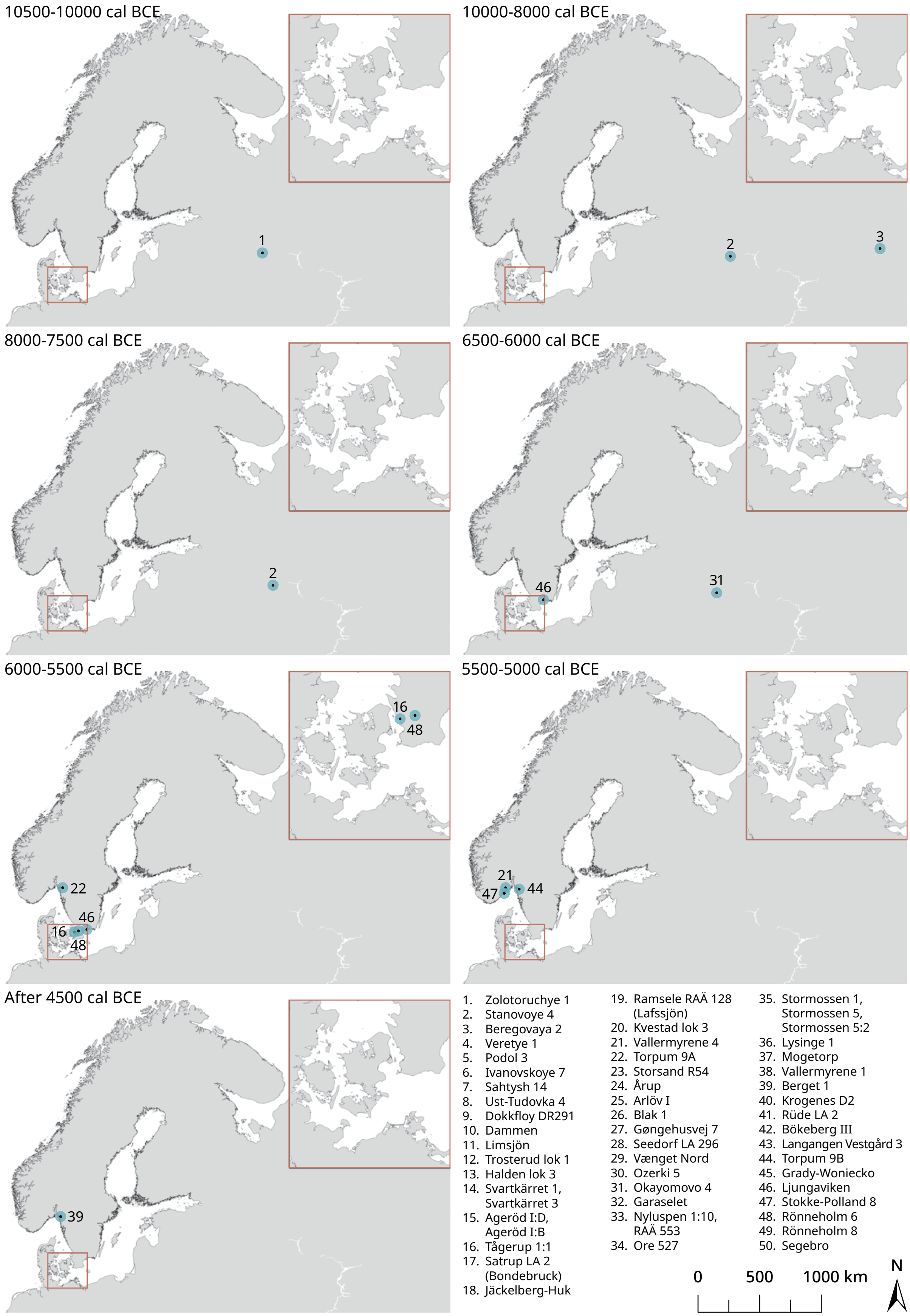
7.3.4 Reliability level 4

This level includes dates with sample evaluation (SE 7-10) from very good and good contexts (CE 1-2). A total of 16 dates are included in this group (Fig. 162). This chronology thus includes dates with the same level of sample reliability as the previous level, but with better contextual reliability. The number of samples is, however, significantly reduced.

At this point, the dates are few and it is not possible to achieve a more general chronology (Fig. 163). The dates seem to group in several clusters, but this is likely due to the lack of dates. Nonetheless, the dates from Western Russia are the oldest from the research area, while the younger dates come from Southern Scandinavia and Norway.

7.3.5 Chronological conclusions based on the radiocarbon dates

The chronologies proposed in this chapter have varying levels of reliability. Furthermore, the chronologies with higher levels of reliability are also based on a smaller number of samples, which makes it difficult, if not impossible, to arrive at a reliable chronology. Clearly, more efforts are needed to establish a reliable chronology for these technological concepts and the dates collected as a part of this project should only be seen as a starting point. Nonetheless, the chronologies suggested in levels 2 and 3 are made up of dates with some contextual and sample-related reliability, and will thus be used as the current basis for the temporal scale of the diffusion process. Here, the single-fronted cores in Western Russia and the handle cores in Southern Scandinavia will be discussed as two separate concepts, as suggested by the technological analyses.



10500-10000 cal BCE

10000-8000 cal BCE

8000-7500 cal BCE

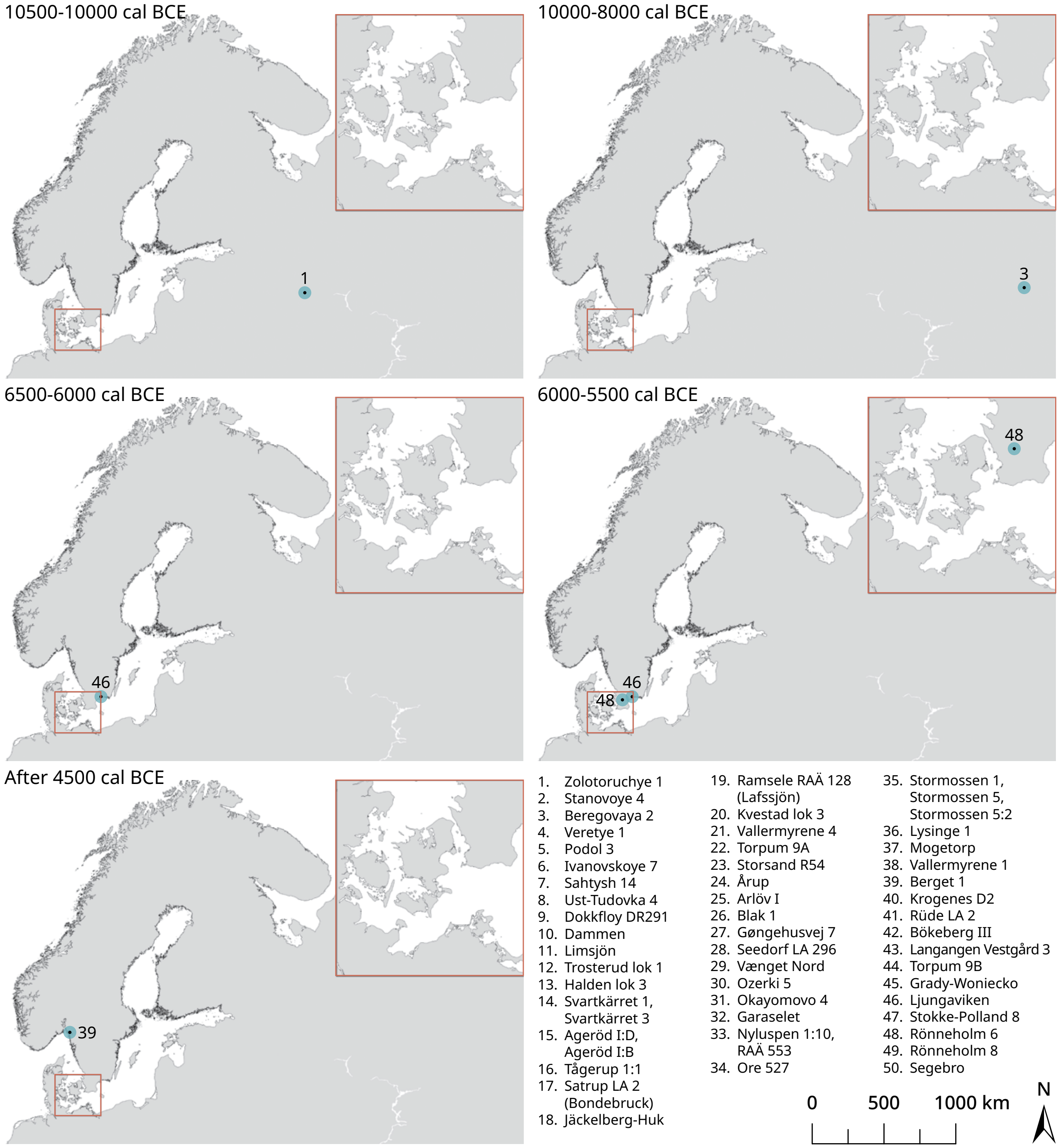
6500-6000 cal BCE

6000-5500 cal BCE

5500-5000 cal BCE

After 4500 cal BCE

1. Zolotoruchye 1
2. Stanovoye 4
3. Beregovaya 2
4. Veretye 1
5. Podol 3
6. Ivanovskoye 7
7. Sahtysh 14
8. Ust-Tudovka 4
9. Dokkfloy DR291
10. Dammen
11. Limsjön
12. Trosterud lok 1
13. Halden lok 3
14. Svartkärret 1, Svartkärret 3
15. Ageröd I:D, Ageröd I:B
16. Tågerup 1:1
17. Satrup LA 2 (Bondebruck)
18. Jäckelberg-Huk
19. Ramsele RAÄ 128 (Lafssjön)
20. Kvestad lok 3
21. Vallermyrene 4
22. Torpum 9A
23. Storsand R54
24. Årup
25. Arlöv I
26. Blak 1
27. Gøngehusvej 7
28. Seedorf LA 296
29. Vænget Nord
30. Ozerki 5
31. Okayomovo 4
32. Garaselet
33. Nyluspen 1:10, RAÄ 553
34. Ore 527
35. Stormossen 1, Stormossen 5, Stormossen 5:2
36. Lysinge 1
37. Mogetorp
38. Vallermyrene 1
39. Berget 1
40. Krogenes D2
41. Rüde LA 2
42. Bökeberg III
43. Langangen Vestgård 3
44. Torpum 9B
45. Grady-Woniecko
46. Ljungaviken
47. Stokke-Polland 8
48. Rönneholm 6
49. Rönneholm 8
50. Segebro



10500-10000 cal BCE

10000-8000 cal BCE

6500-6000 cal BCE

6000-5500 cal BCE

After 4500 cal BCE

Figure 162. Sites represented within time intervals of various lengths, according to reliability level 4. Notice that there is a gap between 8000 and 6500 cal BCE, as well as between 5500 and 4500 cal BCE due to a lack of sites represented within this time period.

Figure 161 (opposite page). Sites represented within time intervals of various lengths, according to reliability level 3. Notice that there is a gap between 7500 and 6500 cal BCE, as well as between 5000 and 4500 cal BCE due to a lack of sites represented within these time periods.

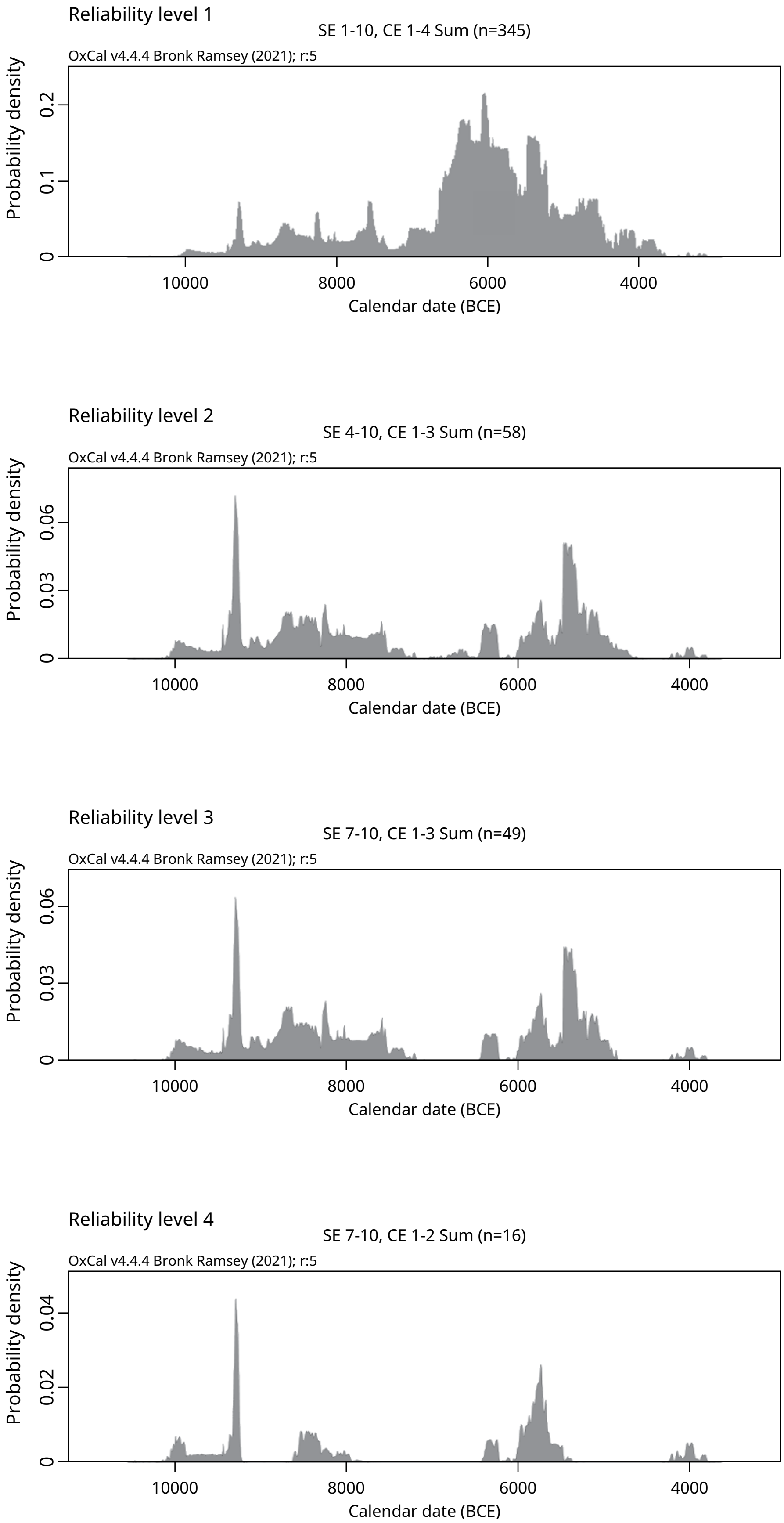


Figure 163. Sum calibration for reliability levels 1 to 4 (using OxCal v4.4.4. Bronk Ramsey 2021; r:5).

Both chronologies suggest that the single-fronted cores have an older chronology, limited to Western Russia, while the handle cores are younger and limited to Southern Scandinavia and Southeastern Norway. The chronological hiatus between the two areas seems to last for ca. 700-800 years, which would suggest that the cores from focus area 1 represent an older tradition and the cores from focus areas 2a and 3 represent a younger tradition within Scandinavia. However, there is a chance that the apparent chronological hiatus could be a result of missing (later) dates from Western Russia, as will be discussed in the next section. Nonetheless, at this point, there are no clear indications for a diffusion process relating to single-fronted cores from Western Russia to Scandinavia during the Mesolithic. Rather, it seems that the single-fronted cores in Western Russia and the handle cores in Scandinavia are represented by two separate chronologies, as based on the currently available radiocarbon dates. Due to unreliable dates from Northern Germany, it is not clear how these materials fit into the chronology, although technological similarities indicate that they should be related to the Scandinavian handle core tradition.

The regional chronology for Western Russia is currently not clear since the available dates come from only three sites (each with long-lasting chronologies). They, however, provide arguments for assuming an earlier presence of single-fronted (pressure) cores in the area, starting at around 10,500 cal BCE. The Scandinavian chronology, however, indicates a first phase of implementation in Southern Sweden starting around 6400 cal BCE. The concept then seems to be implemented in Eastern and Southern Norway around 5600 cal BCE (as also suggested by Reitan 2016). Based on the current dates, the concept seems to be out of use in Southern Sweden by 5200 cal BCE and in Norway by 4800 cal BCE. However, more reliable dates from clear handle core contexts would likely adjust the extent of these chronologies.

The chronology suggested by reliability level 1 indicates a much wider distribution of the handle core concept and the single-fronted cores. This chronology also suggests a rather rapid diffusion process within Scandinavia and Northern Germany. Even though there may be some truth to this development, the low reliability of the dates, at this point in time, does not provide a strong basis for this interpretation.

The chronologies represented by dates of varying levels of reliability show the need for a greater effort to be made with regard to radiocarbon dating. This needs to happen in two ways: Firstly, through the production of more dates clearly related to the handle core concept. This can, for instance, be achieved through thorough sample selection from associated features or from excavations of short-term sites. The contextual relationship between dated samples and handle core finds is important. Secondly, samples need to be chosen with a conscious effort to date reliable sample materials.

7.3.6 Lacking dates from Neolithic contexts?

As already mentioned, the data used for these models has been limited to Mesolithic contexts in Northern Europe. This is due to time restrictions and the focus on a specific Mesolithic technology (the handle core concept) in this work. However, previous research has indicated that the use of single-fronted cores for blade production, along with the implementation of slotted bone tools, continued into the Early Neolithic (until ca. 5500-5400 cal BCE) in Western Russia (*e.g.* Tsvetkova 2019). Although the overview work by Tsvetkova (2019) provides a decent overview of the available flint assemblages from Early Neolithic sites in the Upper Volga region, it relies on small datasets (few finds) from each site and it lacks a source critical discussion regarding the dating of the flint artefacts that are used for the presented typo-chronology. The discussions regarding knapping techniques from the different cores are based mainly on the blade negatives as seen on the cores, rather than on the available blades themselves, which provides only a view of the few final blades produced from a core, rather than a comprehensive view on the blade production in general. Thus, more technological analyses, especially of the blades, would be useful for a comprehensive view on the technologies that relate to the Early Neolithic finds in the area.

On the site Zamostje 2 in the Upper Volga region, eleven slotted bone points have been found in various dated stratigraphic layers, spanning from the Late Mesolithic to the Middle Neolithic (Lozovskaya and Lozovski 2019). However, the authors (*ibid.*) generally highlight a change in several technologies at the onset of the Neolithic, for instance, in the barbed points and figurative arrowheads that are seen with new features related to mass production (*ibid.*, 363). The number of slotted tools included in the study is rather low and the chronology of the site has been suggested to be mixed (cf. Mazurkevich *et al.* 2013). Furthermore, the presence of slotted tools does not assume the presence of single-fronted cores or the use of pressure technique since regular blades can be produced using indirect techniques from a variety of core types, for example, conical cores. The presence of slotted tools in Early Neolithic assemblages in the Urals (Savchenko 2019) should also not be used as an argument for the use of a concept that includes the use of single-fronted cores.

A study by Tsydenova and Piezonka (2014) highlighted the technological continuation from the aceramic Late Mesolithic societies to the Early Neolithic societies in the Baikal region of Eastern Russia. However, even though the use of wedge-shaped cores can be confirmed over these long time-spans, the authors also highlight a level of innovativeness and change in relation to these materials in the Early Neolithic. They showed that the Late Palaeolithic Yubetsu method (which involves blade production from a wedge-shaped single-fronted core) underwent a rationalisation process which eventually resulted in the developments of a new “microprismatic” knapping technique (*ibid.*, 112). This study is a good example of how detailed technological analysis of a broader concept tends to result in a much more complex, and realistic, view on a concept.

The mentioned studies commonly highlight continued social and technological traditions over long time spans in the Late Palaeolithic to the early Neolithic in the Upper Volga region, the Urals and the Baikal region in Eastern Russia. This is based on the presence of slotted bone tools, wedge-shaped cores and small blades being implemented throughout the time frame. However, as has been discussed above, the assumed relationship between slotted bone tools, pressure technique and single-fronted/wedge-shaped cores must be questioned. These artefacts are not necessarily a part of the same *chaîne opératoire* and more local and regional technological studies are needed to understand these relationships in different parts of Northern Eurasia. Furthermore, dating of reliable samples of the artifacts themselves (for bone points) or reliable samples from limited contexts with clear spatial relations (for the flint cores and blades) are necessary for the formation of reliable typo-chronologies in the different regions.

Furthermore, it is possible that the focus on the term “Mesolithic” in this work has excluded sites that could have been relevant for the research questions within this work. This highlights the common archaeological problem related to the use of classic terms, such as “Mesolithic” and “Neolithic”, when they are used as chronological limits. This results in societies that may become excluded since they fall in the grey-zone, as in this case the hunter-gatherer societies that implement pottery (cf. Piezonka 2015). Future studies should focus on describing the technological characteristics of the single-fronted cores and related blade production in these contexts in different parts of Northern Eurasia to see how they relate to the variations in technology found in this study.

7.4 Knowledge transmission in Mesolithic Northern Europe

Based on the results of the technological analysis and the chronological investigations, this chapter will discuss the mechanics and dynamics of the transmission of knowledge relating to the handle core concept on a large spatial scale and in different landscapes.

7.4.1 How did technological knowledge and know-how spread in the research area?

The differing technologies and chronologies of the cores in Scandinavia and Western Russia indicate that they may relate to different technological concepts. The sparse chronological information, however, provides only indications for how these concepts diffused over time. Technological similarities between Western Russia and Lithuania as well as between Southern Sweden, Southeastern Norway and Northern Germany suggest strong social/cultural relationships within these areas at the time of these diffusions.

7.4.1.1 The single-fronted cores in Western Russia

The single-fronted cores from Western Russia (here represented by the site Stanovoye 4) were found in the same contexts as the conical cores related to the CCPC. The cultural layer and the related finds have been interpreted as belonging to the Mesolithic Butovo technocomplex (Averin and Zhilin 2001; Zhilin 2002; 2007; 2009; Zhilin and Matiskainen 2003). The contextual relationship between these finds and the technological similarities between them suggest that they were used in the same general time frame and are part of the same general concept relating to the CCPC at around 10,500 cal BCE. The single-fronted cores might thus reflect a morphological variation within the same techno-concept, or are a supplementary concept for smaller blades that were used alongside the conical cores.

The concept may have diffused from east to west, based on the longer and older chronology of the single-fronted cores in Western Russia (Zhilin 2002; 2007; 2009; Söderlind and Zhilin 2021) and the younger chronologies west of the Baltic. However, the current data does not support such patterns, since a diffusion process from east to west should result in gradually younger dates along the path of diffusion, which is not observable in the current datasets. Nonetheless, chronological data is lacking and further investigations may provide a better overview for the spread of knowledge and know-how relating to these technological concepts. For now, it must be stated that the single-fronted cores in Western Russia lack a chronological relation to the handle cores further west.

It is unclear how the chronology of the single-fronted cores in Southern Lithuania relate to the single-fronted cores and the handle core concept. The complete lack of chronological implications for the concept in Lithuania makes it impossible to place these materials on a temporal scale. There are, however, more technological similarities with the cores from Western Russia than the cores from Scandinavia/Northern Germany, which indicates a stronger relation to the northeast. However, microliths from Late Mesolithic sites in Southern Lithuania show great similarities to Kongemose-related microliths in Southern Scandinavia, which, at least on a typological basis, indicate some relation to the Scandinavian materials (Rimkus 2018). Nevertheless, the lack of single-fronted cores in Northern/Northeastern Poland does not seem to support such a communication route.

7.4.1.2 The handle core concept in Scandinavia/Northern Germany

The results presented here indicate a development/invention of the handle core concept within Scandinavia. The oldest reliable dates are present from Southern Sweden, although strong technological similarities to Eastern Denmark (Ballin 2016; Frandsen 2015; Larsson 1978; Sørensen 2006) indicate that the concept may originate in either of these areas. Furthermore, there is substantial archaeological evidence for close contacts and communication between today's areas of Scania, Zealand and Northern Germany during the Late Mesolithic (Hartz 2009; Larsson 1978; Söderlind 2018; Sørensen 2006; Vang Petersen 2014).

To understand the social conditions and implications for the invention of the HCC in Southern Scandinavia, it is important to consider the technological, and thus social setting in which this innovation occurred. Before the introduction of the HCC around 6400 cal BCE, the knowledge and know-how related to another pressure-based concept was already established in large parts of Scandinavia. This concept is now known as the conical core pressure concept (CCPC, cf. Sørensen *et al.* 2013 and Chapter 2.1.1). As already discussed, this concept included the use of pressure technique, but in Scandinavia the concept did not include the use of single-fronted cores, while in Western Russia the CCPC included the use of both conical and single-fronted cores. The reasons for a difference may be related to a difference in core implementation, social traditions or other indistinguishable motives.

Nonetheless, the introduction of the CCPC across Fennoscandia also involved the introduction of slotted bone points (David and Sørensen 2016; Jensen *et al.* 2020). This concept diffused quickly and was used for almost two millennia before the first finds of handle cores appear in the assemblages.

The similarities between the *chaîne opératoires* of the CCPC and the HCC are obvious. Both technologies involve careful shaping and preparation of the core, with faceted or smooth platforms, followed by blade production using pressure technique (or possibly indirect techniques for handle cores) while the core is being held in some form of device. Additionally, both concepts are used with the intention of producing blades for their use in composite tools or as retouched microliths/blades. The apparent replacement of the CCPC with the HCC also suggests a technological relationship between the concepts. Based on these aspects, it appears that the handle core concept is a technological development of the conical core concept.

Prior to the implementation of the handle core concept, in Southern Scandinavia, a single-fronted core has been reported from the sites Ulkestrup II and Sværdborg II on Zealand, Denmark (Sørensen 2012; Sørensen *et al.* 2013, 40). These cores have been described as a subgroup in the CCPC, called "pressure blade method B" (*ibid.*). Only a few dates place this concept at ca. 7500-7000 BCE. The dates are, however, uncontextualised and therefore not fully reliable. Sørensen (2012) has suggested that this core type may represent a developmental step between the conical core and the later handle core concept. Although this theory would support the presented results, more data and technological studies focused on comparing "pressure blade Method B" to the later HCC are needed to confirm or reject this theory.

The knowledge and know-how related to a re-invention, compared to a completely new innovation, has great potential to spread rapidly, since individuals would already have the skills necessary to implement the new concept with only small adjustments to the already applied methods. This also means that the higher level of complexity, related to the HCC, would not necessarily result in a more difficult or slower transmission of knowledge and know-how since the level of complexity is on the same level as the previous technology. This would help to explain the seemingly fast spread (based on the chronology in reliability level 1) of the concept within Southern Scandinavia and soon after to Central and Northern Sweden, Southeastern Norway and Northern Germany.

A fast spread within Southern Scandinavia, and soon after to adjacent areas, might also have been made possible due to several social, economic and landscape related factors. For instance, the abundance of available flint in Southern Scandinavia will have allowed for experimentation and testing of different ways to produce blades. According to diffusion studies, such factors often result in faster adoptions of innovations (Rogers 2003, 16). Areas and landscapes characterised by a lack of flint, poor quality flint or other raw materials (Norway, Central and Northern Sweden, Northern Germany) seem to have seen a slightly later adoption of the HCC than the areas that are rich in good quality flint such as Southern Scandinavia.

The rapid diffusion process, along with widespread distribution patterns across Scandinavia and Northern Germany, indicates that transmission of knowledge is characterised by both vertical and horizontal directionalities. A vertical or oblique transmission is indicated by the long-lasting traditions relating to the use of the HCC for more than a millennium. Such a long-lasting tradition cannot be maintained without an older generation teaching a younger. Additionally, the technological similarities within Scandinavia and Northern Germany also indicate that vertical/oblique directions were used for knowledge transfer, as they often involve a stronger sense of conservatism (*e.g.* Jordan 2015, 25). The regional variations within the concept, relating to platform preparation and raw material use, may instead suggest a lower degree of social pressure, which is indicative of a horizontal transmission of knowledge (*ibid.*). The fast diffusion also supports the use of horizontal directionalities. Additionally, the fast manner of knowledge transmission could imply the presence of a larger population in the area and/or that people were highly mobile and/or had regular communication with other people in the area and adjacent areas. Large populations and close contacts are two features that have been proven important for a fast diffusion process (Henrich 2001; Shennan 2002; Creanza *et al.* 2017b; Apel *et al.* 2018; Berg-Hansen 2018; Damlien *et al.* 2018).

The regional technological variations could also be explained by stronger communication and contact within communities in certain regions. This would suggest a pattern of regionalisation in the Late Mesolithic, something which has already been observed for earlier parts of the Mesolithic period (Apel *et al.* 2018; Berg-Hansen 2018; Damlien *et al.* 2018). However, ethnographic studies have suggested that distribution patterns relating to different technologies are highly complex and cannot be understood unless the social traditions and norms are understood for the communities in question (cf. Hodder 1982; Jordan 2015). Nonetheless, the regional variations may relate to a process of regionalisation and mobility patterns in different areas of Scandinavia and Northern Germany at the time.

Furthermore, there are some differences in the distribution patterns related to the HCC and the CCPC within the research area. These differences may indicate changes in communication and contacts over time. Broadly speaking, the earlier CCPC appears to cover larger parts of Northern Europe than the later HCC. This pattern can be explained partly by a research bias, as the CCPC has been researched to a larger extent beyond Scandinavia. Nonetheless, some observations can be made regarding the actual differences in distributions. For example, the CCPC is not present in Mesolithic assemblages in Northern Germany (Hartz 2009), which makes it one of the few known areas within Northern Europe in which the earlier CCPC did not exist, but where the later HCC nonetheless appears. This indicates an expansion in the contact networks in the later part of the Mesolithic from Scandinavia towards the south. This is an intriguing trend considering that the Early Mesolithic landscapes of Northern Germany would have been connected to Scandinavia via a land bridge, while the same landscapes in the Late Mesolithic would have been broken up by water after the creation of the Danish isles.

7.4.2 How do different landscape factors play into the transmission of knowledge?

Mesolithic societies lived in close relation to their surrounding landscapes (for a discussion on nature-culture dualism, see *e.g.* Bird-David 1993; Descola 2014). Therefore, environmental changes, including changing temperatures, flooding and changes to flora and fauna, have affected the people living in relation to these landscapes to some extent. How people exactly reacted to environmental changes is archaeologically difficult to prove, but previous studies have shown that people are in general able to cope with external and internal changes in a variety of ways, including adaptation and change (*e.g.* Manninen 2014; Groß *et al.* 2018).

During the Atlantic period, Northern Europe underwent several climatic and environmental changes (as described in Chapter 2). These included an amelioration of temperatures towards warmer and more humid conditions (cf. Björck 1995). This in turn led to an extension of forest coverage across Northern Europe (Zanon *et al.* 2018), a change from fresh water to salt water in the Baltic (Littorina Sea) as well as several changes in the landscapes, flora and fauna (Svenning 2002; Björck 2008; Aaris-Sørensen 2009; Magnell 2017).

It is possible that changes in faunal availability led to changes in hunting-related technologies, which include both the CCPC and HCC. The increased forest coverage across Europe did result in an increase in large game (Svenning 2002; Aaris-Sørensen 2009). An increasing need for related hunting gear could therefore have played a role in the technological change that relates to the two pressure concepts in Southern Scandinavia. Possibly, a change in access to raw material outcrops could have played a role as well.

Around 6500 cal BCE, large land areas in Southern Scandinavia became submerged, which in turn led to the creation of the Danish islands Zealand and Fyn (Hansson *et al.* 2018). This must have affected the communication and contacts between people living in those areas significantly. Soon afterwards, several species of large game also went extinct on Zealand, probably because of the island cut-off (Björck 1995; Aaris-Sørensen 2009).

In relation to this, Sørensen (2006) has suggested that the extinction of elk on Zealand may have led to a change in lithic technology. With the lack of elk antler, he argues, a shift towards the use of deer antler (which is less flexible) occurred. This in turn could have resulted in the use of cores that produce shorter blades (*i.e.* handle cores, *ibid.*). However, technological analyses of antler assemblages from across Europe, including Denmark, have shown long-term implementation of red deer/roe deer for pressure/punch tools throughout the Mesolithic period (David and Sørensen 2016). Elk also seems to be represented only in a small number of assemblages across the research area (David and Sørensen 2016). There are thus few indications that elk antler was used on Zealand exclusively during the Middle Mesolithic before being replaced by red deer antler in the Late Mesolithic. This theory would also imply that contacts were lost to adjacent areas with the creation of the Danish islands.

However, another possible result of the landscape changes could be increased contacts to surrounding areas, because of the increased need for resources. However, this would have required the use of boats for waterway mobility. Boats are often "missing" from the assemblages and sites, although they are often assumed to have been used throughout the Mesolithic period (Glørstad 2013). Reasons for assuming the existence of boats, despite the low number of physical remains (although examples exist, cf. Jenke 2011; Feulner 2012) include the placement of sites along shorelines and on small islands (cf. Bjerck 2017; Schmitt 2017).

Some centuries after the appearance of the handle core concept, another drastic environmental change occurred in Northern Europe, namely the 8.2 ka event (at around 6200 cal BCE). Based on paleoenvironmental data, the mean annual temperature may have decreased considerably, although the effects may have varied regionally (Allen *et al.* 2007). Southern Scandinavia may have experienced lowered temperatures during both the summer and winter, although winter temperatures are generally more responsive to such changes, which would have led to a more significant drop in winter temperatures here (Kobashi *et al.* 2007; Manninen 2014, 13). Such changing temperatures could have resulted in a variety of changes, including a need for warmer clothing, increased/difference in mobility patterns, new technologies, *etc.* To what extent the climate changes, landscape changes and changes in flora and fauna affected the diffusion of the handle core concept across Scandinavia and beyond is not clear. Nonetheless, this technological development could have been invented and diffused during a highly dynamic time period, which would suggest that it may have played a role in the strategies implemented by societies to account for the changing environmental, social and economic conditions during the Mesolithic.

7.5 A wider perspective on the use of single-fronted cores

Although this study has focused on Northern Europe, the technological implications may relate to the diffusion of technologies on a much wider spatial scale. The spread of knowledge and know-how related to the use of pressure technique has been associated with the implementation of single-fronted cores in Northeastern Eurasia already during the Palaeolithic (cf. Inizan 2012). A relationship between these early pressure-based concepts and the pressure concepts found in Northern Europe has been suggested (cf. Desrosiers 2012; Gronenborn 2017), largely due to the early existence of pressure technique in Northeastern Eurasia and a possible gradual spread towards the west (Inizan 2012, but see also Coutouly 2018).

The introduction of pressure technique in Scandinavia in the 9th millennium seems to have its origin in Western Russia and the Butovo technocomplex (*e.g.* Sørensen *et al.* 2013). Yet the appearance of pressure technique in Western Russia is not fully understood and an introduction from further east is possible, although the suggested dispersal over the large area spanning Northeastern Eurasia is only based on a few radiocarbon dates (Coutouly 2018). Several source critical issues relating to the radiocarbon dates and the representativity of data have been highlighted by Coutouly (2018). For instance, the terminology used for investigations of the spread of pressure technique has not been used in a systematic manner, which led to a large variety in the used definitions (*ibid.*). Therefore, further technological and chronological investigations of the diffusion of pressure technique across Northeastern Eurasia are needed before these concepts and their relations can be fully understood.

The possibility of large-scale mobility and contacts across Northern Eurasia is, nonetheless, plausible and has been considered for other technologies during the Mesolithic and the Neolithic (Inizan 2012; Jordan *et al.* 2016; Gronenborn 2017; Piezonka *et al.* 2020). The research area of the current study has been limited to Northern Europe during the Mesolithic, and can therefore not supply more data to the discussion of technological diffusion on such a large spatial scale.

However, the data from within Northern Europe indicates that an independent invention (or re-invention) of single-fronted cores may have occurred within Southern Scandinavia, which shows that also more complex technological concepts (complex is here referring to the fact that it involves a more complicated method for producing blades, pressure technique, as well as relying on several interconnected technologies) can be invented at several points of time, in different areas. The invention of the handle core concept in Southern Scandinavia challenges the idea that more complex technologies must have a single invention centre, from which it diffuses. Instead, the possibility of several invention centres for similar, more or less complex technologies should be considered. This is not to say that large-scale diffusion processes were not common (see *e.g.* Sørensen *et al.* 2013; Damlien 2016b), but it should not be assumed for large areas where technological and/or chronological data is scarce.

7.6 Outlook and future objectives

The results of this project are based on the current state of available technological and chronological data. The limitations largely relate to lacking chronological and technological data, which has implications for the representativity of the results and the interpretations. More studies are needed to further explore the themes included in this thesis.

7.6.1 Representativity of the materials

This study has focused on the initial parts of the *chaîne opératoire* relating to the handle core concept, specifically the shaping of the core, blade production from the core and rejuvenation of the core during blade production. It has been beyond the scope of this study to give a detailed analysis of the later stages of the *chaîne opératoire*, including the further refinement of the blades and their subsequent implementation in tools. Aspects relating to any connected operational chains, such as pitch preparation, bone point technology and the production of core-holding devises or pressure tools, fall beyond the scope of this study. An extended analysis of flakes and chips in each assemblage would allow for further understandings of the *chaîne opératoire.* The addition of refitting studies would have also provided a more comprehensive view, but would have been too time-consuming for the scope of this study.

Another factor that affects the representativity of the materials relates to the selection of sites. For a large-scale study, with a pan-European perspective, the number of sites is very limited compared to the size of the study area. This limits the interpretive value of the results with respect to regional and detailed perspectives. However, generalisations in such a large-scale study are necessary and useful to gain insights into overarching patterns and developments, although more local patterns risk being overlooked. Therefore, the results of this study must be seen as a starting point for an interpretation of the HCC in Northern Europe, but further regional and local studies are needed to approach a more comprehensive understanding of it.

One challenge in the present study was the availability of reliably dated sites as well as datable sample materials. The latter issue relates to a general problem of archaeology in Northern Europe. Here, sandy soils are common in large parts of the area, which results in poor preservation conditions for organic remains, thus reducing the possibilities for successful radiocarbon dating. Since an understanding of the chronology of the handle core concept was a primary aim in this project, the lack of dates and datable materials was a substantial issue. Nonetheless, a more reliable chronology was attained by an evaluation of existing samples than previously attained.

Furthermore, varying lithic sample sizes from both individual sites and from the different focus areas further influenced the representativity and comparability of the data. Archaeological inventories are naturally limited by the availability of finds from the different sites. Balancing of the very heterogeneous datasets, using statistical methods, would therefore be a good addition for future studies that investigate the datasets presented here.

7.6.2 Future areas of interest relating to the handle core concept

For further refinement of the chronology and an understanding of the HCC, more excavations and targeted dating efforts are also necessary to approach the diffusion process. The possibility of existing handle cores in Northwestern Poland (*e.g.* Galiński 1992) still needs further investigation and the technology of the cores there may provide a better understanding of networks and knowledge distribution in the Mesolithic. Nonetheless, the current studies across northern and eastern parts of Northern Poland resulted in few finds relating to the handle core concept, although further investigations of the technology and chronology of the single-fronted cores from the deposit at Grądy-Woniecko (Wawrusiewicz *et al.* 2017) are needed to understand its relation to other areas and traditions. Furthermore, a recent handle core find from Northern France (Ducrocq 2021) also indicates that the southernmost distribution of the concept may require further investigations.

The cores related to “pressure blade method B”, found on sites on Zealand, are assumed to be a type of conical core, and thus included in the CCPC (Sørensen 2012; Sørensen *et al.* 2013; Damlien 2016b, 288). They date to the end of the CCPC phase and have been interpreted as a possible link between the Early/Middle Mesolithic CCPC and the Late Mesolithic HCC (Sørensen 2006). As only a few cores of this type have been studied (Sørensen 2006; 2012), investigations focusing on this material may further refine the connection between the Scandinavian CCPC and the HCC.

One of the most relevant goals for future studies is the production of larger datasets from focus areas 1 and 4 that are contextually sound and datable. In summary, there is a need for more archaeological and chronological data that further develops the results and conclusions of this work. The HCC in Northern Europe during the Mesolithic is one of many technologies that were implemented at the time, and it therefore provides ideal preconditions to understand the transmission of knowledge, social interaction and communication in a time of social and technological change. The integration of other source materials, for instance bone tools (specifically, slotted bone tools), will furthermore generate a more elaborate understanding of the Mesolithic technologies and transmission of knowledge.

8 Conclusions

At the beginning of this project, I set out to understand large-scale mobility, contacts and transmission of knowledge during the Mesolithic in Northern Europe. Although these topics are complex and took place many millennia ago, one way to approach them is via the material culture and technologies that were produced, used and reproduced in relation to these social settings. Since technologies are largely social constructs, the study of them can help bridge the gap between the (here lithic) materials and the social/cultural setting in which they were implemented. The large spatial scale used in this project also allowed me to study transmission of knowledge in a wider Mesolithic setting.

I have mapped and analysed one Mesolithic technology, the handle core concept (HCC), which was characterised by the production of small blades from single-fronted, and often elongated cores. This tradition was suggested to be used in large parts of Northern Europe at this time, although the results of this project have shown that the distribution patterns are somewhat complicated. For instance, I have found that although single-fronted cores appear in many parts of Northern Europe and that there is a morphological similarity between them, there seem to be some differences in the technology in different areas. The cores from Norway, Sweden, Denmark and Northern Germany are more technologically similar to each other than the cores from Western Russia and Lithuania as shown by multivariate analyses. Additionally, the single-fronted cores from Western Russia appear to be much older than the cores in Scandinavia/Northern Germany. However, single-fronted cores in Neolithic contexts in Western Russia still require further research to understand their relation to the handle core concept further west. Little is, however, known about the chronology of the cores in Lithuania.

It is further proposed that the single-fronted cores in Western Russia are more related to an earlier technological concept that was centred on blade production from conical cores using pressure technique (CCPC). This is based on the contextual relation between the conical cores and the handle cores within the same stratigraphic layers, and thus the same temporal setting. Within Scandinavia, however, the HCC appears to replace the tradition relating to the CCPC in the transition between the Middle and the Late Mesolithic (in a Scandinavia chronology). Nonetheless, I have argued for a close relationship between the two concepts within Scandinavia. The *chaîne operatoires* related to the two Mesolithic concepts are very similar, with differences only in core preparation and possibly in relation to the holding of the core during knapping. The techniques and methods used to produce the blades and the implementation of the resulting blades were used in a very similar manner, which is the basis for the interpretation that the HCC is a re-invention or technological development from the CCPC (as discussed in Chapter 7.4.1.2). Although the radiocarbon dates from Northern Europe come with contextual and sample-related issues, the current chronology suggests that this re-invention took place somewhere in Southern Scandinavia, probably in Scania (Sweden) or Zealand (Denmark) around 6400 cal BCE.

The available chronology also suggests a rapid spread of the knowledge and know-how relating to the HCC around 6400 cal BCE within Southern Scandinavia soon after its invention, and also towards Western Sweden and to Southeastern Norway. In the following centuries, the knowledge and know-how relating to the concept seems to have been established in most of Scandinavia and in Northern Germany. This fast diffusion might have been possible due to several factors. Firstly, knowledge and know-how relating to pressure technique was already established in the area. This similar level of complexity allows for an easier, and thus faster, diffusion process. Secondly, common availability of flint in Southern Scandinavia would have allowed for low-risk testing of the concept prior to fully incorporating it in one's skill-set. Thirdly, the rapid diffusion might also relate to the directionality of the transmission of knowledge. If the concept initially spread horizontally, it would explain the fast diffusion process. However, the seemingly long chronology of the concept, stretching more than a millennium, must be explained by the use of vertical transmission of knowledge across generations. Thus, both a horizontal and a vertical transmission of knowledge played a role in the spread of this concept, over large areas and during a long period of time. Finally, the fast diffusion might also be related to an increase in population or that regular communication/contacts across Southern Scandinavia were already established in the area in which knowledge and know-how could easily spread. The idea of a strengthening of regional patterns during the earlier parts of the Mesolithic (Berg-Hansen 2018; Damlien *et al.* 2018) could therefore be regarded as having continued during the latter parts of the Mesolithic as well, although more regional studies would be needed to confirm such patterns. Additionally, there is a significant need for an improvement of the chronologies that lie at the base of these interpretations before the development and implementation of the HCC can be fully understood chronologically (Chapter 7.2.2).

During the Late Mesolithic, the climate and landscapes of Northern Europe are characterised by generally warmer and more humid conditions (in the Atlantic chronozone), with increased forests and an increase in species of mammals, such as elk, deer and beaver, which like to live under the mentioned conditions. It is a dynamic time period and it is possible, but not certain, that some of these changes played a role in the innovation (or re-invention) of the HCC. For instance, the extinction of elk on Zealand may have affected the contact and exchange networks in the respective areas, in one way or another. Alternatively, the cut-off of the Danish isles may have resulted in a change in the level of (regional) mobility and contacts to adjacent regions at the time, either resulting in less contact or more contacts. The latter would fit the patterns indicated by the fast transmission of knowledge, as discussed above. Nonetheless, the landscape changes cannot be solely responsible for the appearance of handle cores during the Mesolithic, since landscape aspects relate to diverse social and cultural factors that would have been dealt with depending on norms, traditions, *etc.*

The study of technology, and the handle core concept specifically, resulted in a unique chance to understand a technological concept on a large spatial scale. The similarities and differences between different parts of the research area indicate that regional/local social spheres or networks were established in which people were in contact and interacted with each other on a regular basis, which created some regionalised patterns in the material culture. However, contacts and communication must have also extended these networks, as seen in the large-scale distribution of knowledge and know-how relating to the HCC. The rapid spread of knowledge and know-how relating to this concept suggest that these networks relied, to a significant degree, on a horizontal transmission of knowledge. These results show the complex nature of knowledge transmission within Mesolithic societies, just as within any modern or past society.

Mesolithic mobility, contacts and transmission of knowledge in Northern Europe seem to have been characterised by an interplay of local, regional and transregional communication and exchange. Each of these topics is highly complex and relates to a variety of internal and external factors. Nonetheless, the repeated contacts and interactions between people on different spatial scales is a red thread throughout these stories. These interactions form networks in which learning, knowledge and social traditions are created, implemented and diffused. Diffusion studies have shown that innovation and change happen where people with different types of knowledge meet and interact. The invention of the handle core concept in Southern Scandinavia represents one such example. In the meeting point between Scandinavia and continental Northern Europe, many people with varying histories and knowledge sets have met and developed a new variant of blade production from a single-fronted core (a handle core). Migration, social interaction and the possibility to learn from others have thus been important features in the creation of new ideas, innovations and social traditions in Mesolithic Northern Europe.

9 Summary

9.1 Chapter 1 – Introduction

Topics relating to mobility, contacts and the transmission of knowledge are relevant, both for current societies as well as for Mesolithic ones. Therefore, the study of these topics during the past can aid our understanding of the social implication of migration, communication and learning today by accessing long-term perspectives of change. This work deals with these topics in relation to the transmission of knowledge and know-how through analyses of the Mesolithic Handle Core Pressure Concept (HCPC), which is a specialised concept centred around blade production from an elongated and single-fronted core, using pressure technique. The research area includes large parts of Northern Europe.

Migration and diffusion processes occurred on various temporal and spatial scales during the Mesolithic (*e.g.* Inizan 2012; Sørensen *et al.* 2013; Damlien 2016b; Günther *et al.* 2018; Kjällquist and Price 2019). These processes can be studied based on the materials and technologies that disperse along these routes.

Lithic remains are one of the foremost materials to study past technologies due to their longevity and readability. The lithic remains were produced, implemented and discarded within social settings, often in the interaction between people. Therefore, technology can be seen as a highly social phenomenon (Lemonnier 1976; Leroi-Gourhan 1993 [1964]; Dobres 2000; Jordan 2015). The *chaîne opératoire* approach is useful for studies of technology, since it involves understanding all steps of the production, use and discarding of an artefact. Each step in the operational chain thus relates to choices and actions of the flint knapper as well as the materials created in the process (Lemonnier 1976; Leroi-Gourhan 1993 [1964]; Dobres 2000; Eriksen 2000; Jordan 2015).

As indicated by some anthropological studies (cf. Hodder 1982; Jordan 2015), technologies come with their own individual sets of social, material, bodily and cognitive processes. Different technologies are thus not implemented or learnt according to the same social traditions. Therefore, individual technologies must be understood on a case-by-case basis to understand their dynamics and social traditions, along with the mechanics involved in the diffusion process (Jordan 2015, 362).

The materials used in this work to investigate these themes are focused on blade production with the handle core pressure concept (HCPC). The concept has been well researched within Scandinavia (*e.g.* Larsson 1978; Knutsson 1980; Olofsson 1995; Sørensen 2001; 2006; Frandsen 2015) and to some degree also in Northern Germany (*e.g.* Hartz 2009; Söderlind 2018). However, this is the first time that the concept is investigated on a larger spatial scale.

Blade production from the cores is done by means of pressure technique, which adds some technological complexity to the concept, and in turn means that the concept must have been learned and taught in a social setting where both knowledge and know-how can be transferred (Schiffer 1972; Lemonnier 1976; 1980; Pelegrin *et al.* 1988; Pelegrin 1990; Leroi-Gourhan 1993 [1964]; Rogers 2003).

However, the chronology of the HCPC is not well-known and the current chronology is mainly based on dates produced from rather unreliable sample materials or samples from contexts that are not directly related to the finds (cf. Olofsson 2003). Despite these chronological issues, the handle cores have been used within established typochronologies within Scandinavia for a long time (*e.g.* Becker 1953; Mikkelsen 1975). An effort will therefore be made to investigate the chronology of the HCPC, mainly by compiling and evaluating existing radiocarbon dates, but also through the addition of some new radiocarbon dates from carefully selected contexts.

The objective of the project is to investigate contacts, communication and transmission of knowledge during the Mesolithic in Northern Europe. This will be done by tracing and mapping the knowledge and know-how relating to a technological concept, centred around the handle core concept. The posed research questions to approach these topics relate to three overarching themes with the respective research questions:

1. The technology of the handle core concept
    - Which technological attributes define the handle core concept?
    - Which technological similarities/differences within the concept exist in and between different parts of the research area?
2. The chronology of the handle core concept
    - What is the chronology of the handle cores within and beyond Scandinavia?
    - How does the concept diffuse in the research area?
3. Transmission of knowledge and know-how in the research area
    - What characteristics of knowledge transmission are related to the handle core concept?
    - Where is the point of origin and how does the knowledge and know-how spread throughout the research area?
    - What are the social implications for the spread of the handle core concept in different landscapes and during the dynamic environments of the Mesolithic?

Technological attribute analysis is used to map the concept in different parts of the research areas. The data is subsequently subjected to descriptive and multivariate analyses to highlight technological differences and similarities in different parts of the research area. These results are then understood on a basis of cultural transmission theory, and with perspectives from diffusion studies.

9.2 Chapter 2 – Previous research

The previous research is focused on three general themes: the definition, use and chronology of the handle core concept, Mesolithic mobility and Mesolithic landscapes. The handle cores have been substantially researched in Scandinavia. A large part of the research history has focused on the definition and use of the core, which has changed from very descriptive morphological definitions (and implied uses) to metric definitions before resulting in a more technological definition. The latter has focused on how the handle cores, and blades, were made and the processual chain that is involved. This highlights that the various perspectives throughout the research history have played important roles for its understanding today. In this project, however, technology will also be used to approach highly social perspectives related to mobility, contacts and the transmission of knowledge.

The handle cores have played an important role as a chronological marker for the Late Mesolithic within Scandinavia, both before and after the introduction of radiocarbon dating. Nonetheless, the chronology of the concept is largely based on typological analyses. Furthermore, the chronological investigations that focused on Northern Sweden (Olofsson 2003) have highlighted several source critical issues to the existing radiocarbon dates. These issues are relevant for all available dates and relate to the use of poor/unknown sample materials, imprecise dates and the use of a variety of dating methods. Additionally, the contextual relationship between cores and dates has been criticised repeatedly (*e.g.* Cullberg 1972; 1974; Olofsson 2003).

During the Mesolithic, large-scale migration and diffusion patterns have been indicated by the spread of various technologies. Within Northern Europe, one such technological diffusion relates to the Early Mesolithic Conical Core Pressure Concept (CCPC) (Sørensen *et al.* 2013; Günther *et al.* 2018). Some technological trajectories are also seen within Northern Eurasia, related to the spread of pressure technique during the Palaeolithic/Mesolithic (cf. Smith 1974; Desrosiers 2012; Gronenborn 2017; Coutouly 2018) and the spread of pottery in forager societies in the Early Neolithic (Piezonka 2015; Piezonka *et al.* 2017; Jordan *et al.* 2016; Piezonka *et al.* 2020).

These patterns indicate that large-scale migration patterns, along with extensive multi-scale social networks, have existed during large parts of prehistory. These diffusion processes must be understood, not only within their social settings but also within the landscape and climate conditions where they took place. During the Atlantic period, when the handle core concept was implemented, the landscapes of Northern Europe were undergoing the same changes to a certain extent. The climate was characterised by raising temperatures, which in turn led to high humidity levels, rising sea levels, changes in salinity and increasing forest coverage (cf. Björck 1995; Stroeven *et al.* 2016; Hansson 2018; Zanon *et al.* 2018). These conditions in turn led to rather homogeneous faunal variability with large quantities of large game that preferred the dense forested conditions (Aaris-Sørensen 2009). The landscapes of Northern Europe also experienced regional and local climatic and environmental variations and conditions. In particular, some areas that used to be covered by glacial ice, such as Scandinavia, were characterised by a lot of change. In Southern Scandinavia, shifting shorelines, the creation of the Danish isles and regional faunal extinction events (Aaris-Sørensen 2009; Magnell 2017) must have affected the people living in these areas (Björck 2008). Furthermore, around 6200 cal BCE, a sudden cold spell in relation to the 8.2-event (BP), may have further affected the people living in Northwestern Europe at the time (Kobashi *et al.* 2007; Manninen 2014).

9.3 Chapter 3 – Theoretical framework

This chapter presents the theoretical framework used in this thesis. It focuses on the approach that technology is a social phenomenon, since it is produced, used and maintained in the interactions and relationships between people, and depends on human agency (Dobres 2000). This is supported by Jordan (2015) who argues that technology is a "human social tradition". He furthermore argues that technological traditions are material manifestations between cultural information and the manner of which it is inherited, reproduced and transformed by actions of people and communities (*ibid.*). This work is based on cultural transmission theory, in which cultural traits are argued to propagate similar to genetic traits, although, via social learning rather than evolutionary processes and randomness (cf. Cavalli Sforza and Feldman 1981; Boyd and Richerson 1985; Shennan 2002; Creanza *et al.* 2017a). Additionally, cultural transmission theory supplies terms and concepts from genetics/biology that can be used for a discussion of cultural transmission (Shennan 2002, 33-35; Jordan 2015, 18-19). Material culture and technology can therefore be used to approach social learning and the transmission of knowledge. The use of a *chaîne opératoire* has been suggested as a good method to study artefacts and debitage in relation to the knappers' actions, choices and goals (Schiffer 1972; Lemonnier 1976; 1980; Pelegrin *et al.* 1988; Pelegrin 1990; Leroi-Gourhan 1993 [1964]). The *chaîne opératoire* contains two fundamental elements, knowledge and know-how. Knowledge represents the information that is needed in order to understand the steps required to reach an anticipated product. Know-how instead represents the information necessary to accomplish these steps (Pelegrin 1990, 117-118). The theoretical basis of this work is also based on an understanding of diffusion processes. The patterns involved in the diffusion of ideas largely come from studies relating to sociology, social psychology, anthropology, education, communication studies, marketing and geography. New technologies are defined as an innovation, and the diffusion of such an innovation has been shown to follow some general patterns, depending on the social mechanics involved (*e.g.* Rogers 2003). Based on diffusion studies, the reasons behind the making of innovations, and the drivers of them, can provide some possible reasons why and how the handle core concept may have emerged (*ibid.*). Furthermore, the mechanics involved in the transmission of knowledge, such as directionality, activeness of the teacher, the social setting in which learning takes place and the level of formality involved during learning, may also affect the diffusion process (*e.g.* Shennan 2002; Jordan 2015). Based on the relevant aspects of cultural transmission theory and diffusion studies, a series of assumptions is posed to be returned to for the discussions in Chapter 7.

9.4 Chapter 4 – Methods

To approach the mechanics involved in the transmission of technological knowledge and know-how during the Mesolithic, I focus on the diffusion of the handle core pressure concept (HCPC). The concept is investigated by means of technological attribute analysis, concentrated on the handle cores and the blades produced from them. The material studies are conducted for five focus areas within Northern Europe. Based on the technological attributes from different focus areas, the operational stages can then be approached through a form of "mental reassembly" of the materials. Through this process, the finds are understood as a part of their *chaîne opératoire* (Pelegrin 1990; 2000, 74; Inizan *et al.* 1999, 16; Ballin 2000). The data collected from the technological attribute analyses were then analysed using both univariate and multivariate analyses, using R-Studio (Version 1.0.153). Both a hierarchical cluster analysis and a correspondence analysis were used to explore the collected datasets. This was done to understand which attribute variants characterise the concept in different focus areas. The establishment of a chronology for the handle core concept was mainly attempted by re-evaluating previously made radiocarbon dates. This re-evaluation focused on both the validity and reliability of the dates themselves as well as the contextual relationship between the dated samples and the handle core finds. A small number of AMS-dates were also produced, additionally, to provide a better chronological basis for certain areas/sites/contexts.

9.5 Chapter 5 – Materials

To understand the technological character of the handle core concept in Northern Europe, lithic assemblages from 23 sites in five focus areas are analysed. Focus area 1 is the Upper Volga region in Western Russia, with the site Stanovoye 4. Focus area 2a is Southern Sweden, including the sites Ljungaviken, Tågerup and Rönneholm 6. Focus area 2b is Northern Germany, including the sites Satrup LA 2, Dreggers LA 3 and Owschlag LA 183. Focus area 3 consists of Southeastern Norway and the sites Lokalitet 3 (Halden excavations), Krøgenes D2, Stene terrasse, Stokke/Polland 8 and Vallermyrene 4. Focus area 4 includes Southern Lithuania and the sites Dubiciai 1 (Salaitė), Dusia 8, Gribasa 4, Kabeliai 1, Katra 1, Maksimonys 4, Margiai 1, Margiai 2, Netiesai 1, Papiskes 4 and Varene 2. The sites from the different focus areas were chosen based on the presence of handle cores and handle core blades in the assemblages. Most sites were also chosen due to the presence of dated/datable materials in spatial relation to handle core finds, although the Lithuanian assemblages are included despite a lack of datable materials. The chapter also discusses the representability of the analysed materials and provides a brief description of each site from which materials were analysed.

9.6 Chapter 6 – Results

The data is first presented based on univariate statistics from a regional (within focus areas) and a large spatial scale (between focus areas). Secondly, the results of the statistical tests and multivariate analyses are addressed. Based on these results, the *chaîne opératoire* from each focus area is suggested. Additionally, the newly dated radiocarbon samples are presented.

The data from the cores demonstrates regional differences relating to three attributes seen on the cores: platform preparation (PMORPH), side preparation (KS_comb) and frontal preparation (PPCD). The cluster analysis of these attributes indicated a regional division, where most of the cores from Western Russia clustered with most cores from Southern Lithuania (in cluster 1). Cluster 2 instead contained most of the cores from Southern Sweden, Northern Germany and Southern/ Central Norway. This shows that there are more technological similarities between the cores within Scandinavia/Northern Germany, while stronger similarities also exist between the assemblages from Western Russia and Southern Lithuania.

The results from the correspondence analysis of the data highlighted that Cluster 1 was characterised by faceted platforms (PMORPH-2), core sides with cortex (KS_comb-11) or cortex/simple preparation combinations (KS_comb-12, KS_comb-21) and frontal preparation involving trimming and/or abrasion on top of the platform (PPCD-4 and PPCD-5). Cluster 2 was instead more varied in character, but included a larger presence of smooth platforms (PMOPRH-1), core sides with lateral edge preparation (KS_comb-13, 23, 31-33) and frontal preparation characterised by trimming and abrasion (PPCD-1, 2 and 3).

Although the data from the blades has a more homogeneous character, some regional variations were suggested, relating to the presence of Wallner lines (WN), dorsal preparation (SFPD) and platform preservation (SFPE). This dataset is, however, limited to data from Scandinavia and Northern Germany and therefore does not reflect the entire research area. Nonetheless, the cluster analysis indicated that the different focus areas are rather similar in terms of these attributes, but with slightly higher similarity between Southern Sweden and Northern Germany compared to Southeastern Norway. Focus area 2a seems to have rather strong associations to the attribute variations fine Wallner lines (WN1), abrasion (SFPD-1) and a weaker association to smooth platforms (SFPE-2). Focus area 2b is rather weakly associated with the attribute variations broad Wallner lines (WN-2), abrasion and trimming (SFPD-3) and crushed platforms (SFPE-3). Lastly, focus area F3 seems to correspond strongly to the attribute variations no Wallner lines (WN-0), no platform preparations (SFPD-0) and trimming (SFPD-2) as well as faceted platforms (SFPE 57).

These technological differences between the different focus areas lead to some differences in the suggested *chaîne opératoires*, mainly relating to the manner in which the platform is prepared and maintained as well as how the sides of the core are prepared, which may have implications for how the core is held. Some of the variations may relate to the different raw materials used in the different parts of the research area, but some of the differences likely relate to variations within regional social traditions. The cores from focus areas 1 and 4 are characterised by a different type of front preparation, located on top of the platform by the front. Most of the cores were prepared with faceted platforms. The core sides are instead less prepared, as seen by larger amounts of remaining cortex as well as less lateral edge preparation. Cores from focus areas 2a, 2b and 3 are instead characterised by a higher degree of trimming and/or abrasion on the core front and no trimming on top of the core platform. Additionally, a higher proportion of cores has smooth platforms, although faceted platforms are also not uncommon. The core sides commonly display flake negatives produced during the shaping process as well as an additional type of preparation, located on the lateral edges of the cores. These lateral edge preparations were likely done to prepare the core for placement in a holding device (Callahan 1985; Sørensen 2001; 2003; 2006).

The new dates from the Stanovoye 4 site largely support the previously suggested chronology of the site. The new dates from Ljungaviken help pinpoint the activities in Hut 3 to sometime around 6058-5639 cal BCE.

9.7 Chapter 7 – Discussion

The results of my technological analyses indicate several technological differences in the assemblages which are characterised by single-fronted blade cores in Northern Europe. The understanding of the HCPC technology on a large spatial scale (across Northern Europe) and on a medium spatial scale (within Scandinavia and Northern Germany) provides clear indications to discern different diffusion processes. However, it also becomes clear that a small-scale (regional) understanding of the concept does require more data overall as well as more detailed data from each focus area to obtain local chronologies. Variation in core and blade sizes across Northern Europe is likely partly related to the implementation of different raw materials, with varying knapping qualities. This implies that some of the social traditions related to the concepts were flexible. However, there are also areas with knappable lithic materials in Northern Europe that lack any finds related to the HCPC, which means that factors other than raw material availability must have played a role in the distribution patterns. The key differences between the focus areas east and west of the Baltic Sea are reflected by a variety of factors, including variation in knapping methods/techniques for blade production and varying raw material availabilities. As there are several, highly different characteristics of the single-fronted cores between the areas, I argue for a difference in the manner of implementing the concepts.

Due to the obtained results, which show a reliable differentiation between the east and west, it can be assumed that different social and technological traditions relate to these concepts. As the results are consistent over a larger area, they can even relate to different networks of contacts and communication and thus underline that two different traditions can be seen in the use of single-fronted cores in Northern Europe during the Mesolithic: a Scandinavian tradition and an East European tradition. These different concepts are henceforth referred to as the *HCPC* (in Scandinavia/Northern Germany) and *single-fronted cores* (for Western Russia and Lithuania). The more general term *single-fronted core* is used for the eastern cores due to the need for further investigations into their technological character.

Within Scandinavia and Northern Germany, some more local/regional variations in the technology of the HCPC can be observed. These include a variation in platform preparation and possibly variation related to the methods involved during blade production. However, the technological attributes on the blades indicate that pressure technique was used throughout the area.

The chronologies proposed in the discussion have varying levels of reliability (level 1-4, with level 4 as the most reliable level). The more reliable chronologies are based on a smaller number of samples, which makes it difficult, if not impossible, to arrive at an overall reliable chronology. Clearly, more efforts are needed to establish a reliable chronology for these technological concepts and the dates collected as a part of this project should only be seen as a starting point.

However, some temporal trends were indicated by the dates with some contextual and sample-related reliability. These chronologies suggest that the single-fronted cores (in Western Russia) have an older chronology, while the handle cores (in Scandinavia/Northern Germany) are younger. The chronological hiatus between the phases may relate to missing (Neolithic) dates from Western Russia. However, no gradual diffusion process can be seen in the radiocarbon dates from Western Russia towards Northern Europe at this stage. Instead, it seems that the dates indicate two separate chronologies, one in Western Russia and one in Northwestern Europe.

The regional chronology for Western Russia is currently not clear, since the available dates are represented by only by three sites (each with long-lasting chronologies). However, they provide arguments to assume an earlier presence of single-fronted (pressure) cores in the area, starting already around 10,500 cal BCE. The Scandinavian chronology indicates a first phase of implementation in Southern Sweden, starting around 6400 cal BCE. The concept then seems to be implemented in Central and Southern Norway, around 5600 cal BCE. Based on the current dates, the concept seems to be out of use in Southern Sweden by 5200 cal BCE and in Norway by 4800 cal BCE. However, more reliable dates from clear handle core contexts would likely adjust the extent of these chronologies.

Furthermore, the less reliable chronology suggested by reliability level 1 indicates a much wider distribution of the handle core concept and the single-fronted cores. This chronology also suggests a rather rapid diffusion process within Scandinavia and Northern Germany, although the unreliable nature of the dates makes for a rather uncertain interpretation.

The contextual relationship between the single-fronted cores and conical cores from Western Russia, and the technological similarities between them, suggests that they were used in the same general time frame, and are part of the same general concept relating to the CCPC. The single-fronted cores reflect a morphological variation within the same techno-concept, or are a supplementary concept for smaller blades that were used alongside the conical cores. The introduction of the CCPC into Fennoscandia from Western Russia in the 9th millennium BCE, however, did not include the use of single-fronted cores. The reasons for this may relate to a difference in core implementation, factors relating to social traditions or other indistinguishable motives.

The lack of handle cores from early stages of the Mesolithic in Scandinavia, along with the earliest dates from Southern Sweden, indicates that the HCPC represents a technological development (or re-invention, *sensu* Rogers 2003) from the older CCPC. This theory is further supported by the technological similarities between the CCPC and the HCPC, and the similarities in their *chaîne opératoires*. The knowledge and know-how of a technological re-invention has great potential to spread rapidly, since individuals would already have the skills necessary to implement the new concept, with only small adjustments in the applied methods (Rogers 2003). This helps to explain the seemingly fast spread (based on the chronology in reliability level 1) of the concept within Southern Scandinavia and soon after to Central and Northern Sweden, Southern and Central Norway and Northern Germany. This rapid diffusion might have been possible due to several social, economic and landscape related factors, including the possibility of technological testing and experimentation in flint rich areas. Furthermore, the rapid diffusion process, along with widespread distribution patterns across Scandinavia and Northern Germany, indicates that transmission of knowledge occurred via both vertical and horizontal directionalities. A vertical or oblique transmission is indicated by the long-lasting traditions relating to the use of the HCPC for more than a millennium. Additionally, the morphological similarities within Scandinavia and Northern Germany also indicate that vertical/oblique directions were used for knowledge transfer, as they often involve a stronger sense of conservatism. The regional variations within the concept, relating to platform preparation and raw material use, may instead suggest a lower degree of social pressure, which is indicative of a horizontal transmission of knowledge. The fast diffusion also supports the use of horizontal directionalities. Additionally, the fast manner of knowledge transmission could imply the presence of a larger demographic density in the area and/or that people were highly mobile and/or had regular communications with other people in the area and adjacent areas. It is thus likely that a transmission of knowledge was made possible through a variety of directionalities and social settings simultaneously.

The regional/local technological variations within Scandinavia and Northern Germany could be explained by stronger communication and contact within certain communities. This would suggest a pattern of regionalisation in the Late Mesolithic, which has also already been observed for earlier phases of the Mesolithic period (Apel *et al.* 2018; Berg-Hansen 2018; Damlien *et al.* 2018).

It is possible that changes in faunal availability would have led to changes in hunting-related technologies, which includes both the CCPC and HCPC. The increased forest coverage across Europe did result in an increase in large game (Svenning 2002; Aaris-Sørensen 2009). A heightened need for related hunting gear could therefore have played a role in the technological change that relates to the two pressure concepts in Southern Scandinavia. Around 6500 cal BCE, large land areas in Southern Scandinavia became submerged, which in turn led to the creation of the Danish islands Zealand and Fyn (Hansson *et al.* 2018). This must have affected the communication and contacts between people living in these areas significantly, since they had to deal with the loss of familiar land areas as well as new waterways. Changing landscapes, for instance, with areas covered by water turning to swamps, and later dry land, would have resulted in new experiences and resources as well. Soon after this, several species of large game also went extinct on Zealand, probably because of the island cut-off (Björck 1995; Aaris-Sørensen 2009). These changes may also have affected the economies and subsistence strategies of the people living in the area, resulting in either decreased or increased contacts towards adjacent areas, depending on the level available of water-based travel and the effects on contacts and communication at the time.

Whether or not the climate changes, landscape changes or changes in flora and fauna at the time played a role in the diffusion of the handle core concept across Scandinavia is not clear, but the new technology related to the HCPC was invented and diffused during this extremely dynamic period.

9.8 Chapter 8 – Conclusions

The study of technology, and the handle core concept specifically, resulted in a unique chance to understand a technological concept on a large spatial scale. The similarities and differences between the materials in different parts of the research area indicate that regional/local social spheres or networks were established, in which people were in contact and interacted with each other on a regular basis, which created some regionalised patterns in the material culture. However, contacts and communication must have also extended these networks, as seen in the large-scale distribution of knowledge and know-how relating to the HCPC. The rapid spread of knowledge and know-how relating to this concept suggest that these networks relied, to a significant degree, on a horizontal transmission of knowledge.

These results showcase the complex nature of knowledge transmission within Mesolithic societies, just as within any modern or past society.

In general, Mesolithic mobility, contacts and the transmission of knowledge seem to have been characterised by an interplay of local, regional and transregional communication and exchange. Through these social networks, there was an exchange of all types of social and cultural traditions, resources and learning. Diffusion studies have shown that innovation and change happen where people with different knowledge sets meet, and this seems to also have been the case during the Mesolithic. Migration, social interaction and the possibility to learn from others are thus important features in the creation of new ideas, innovations and social traditions.

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Appendices

Appendix I – Data sets for cores and blades

1 Data sets for cores

The summarised datasets for the cores from each focus area are also digitally available.

Table 1. Data set for cores – Focus area 1.

Local scale					
Attribute	**Site**	**Total no. of finds**	**No. of finds**	**(%)**	**Attribute morphology**
(KSFA) Platform design	Stanovoye 4	27	25	92.6%	one platform (1)
			2	7.4%	2, opposing (2)
			0	0.0%	2 or more, otherwise arranged (5)
(KSFN) Platform use	Stanovoye 4	27	25	92.6%	one main platform (1)
			2	7.4%	2 equivalent PF, successively (2)
(HCF) Handle core on flake	Stanovoye 4	26	19	73.1%	not made on flake (0)
			7	26.9%	made on flake (1)

Local scale					
Attribute	**Site**	**Total no. of finds**	**No. of finds**	**(%)**	**Attribute morphology**
(KAAN) Core front design	Stanovoye 4	27	23	85.2%	one core front (1)
			0	0.0%	2 independent (2)
			4	14.8%	2 opposing (3)
(KR) Back	Stanovoye 4	23	4	17.4%	cortex (1)
			19	82.6%	preparation negative (3)
			0	0.0%	one big negative (ventral/dorsal) (4)
(KS1) Side 1	Stanovoye 4	27	5	18.5%	cortex (1)
			11	40.7%	preparation negatives (3)
			7	25.9%	one big negative (ventral/dorsal) (4)
			0	0.0%	cortex + platform prep (6)
			4	14.8%	preparation negs + plat prep (7)
			0	0.0%	one negative + platform prep (8)
(KS2) Side 2	Stanovoye 4	26	5	19.2%	cortex (1)
			14	53.8%	preparation negatives (3)
			5	19.2%	one big negative (ventral/dorsal) (4)
			0	0.0%	cortex + platform prep (6)
			2	7.7%	preparation negs + plat prep (7)
			0	0.0%	one negative + platform prep (8)
(EPANG) Exterior platform angle	Stanovoye 4	27	0	0.0%	50 degrees
			2	7.4%	55 degrees
			0	0.0%	60 degrees
			1	3.7%	65 degrees
			4	14.8%	70 degrees
			5	18.5%	75 degrees
			4	14.8%	80 degrees
			4	14.8%	85 degrees
			4	14.8%	90 degrees
			3	11.1%	95 degrees
			0	0.0%	100 degrees
			0	0.0%	105 degrees
			0	0.0%	110 degrees
			0	0.0%	115 degrees
(PMORPH) Platform morphology	Stanovoye 4	29	3	10.3%	smooth/plain (1)
			25	86.2%	faceted platform (2)
			1	3.4%	partial faceting (3)

Local scale					
Attribute	**Site**	**Total no. of finds**	**No. of finds**	**(%)**	**Attribute morphology**
(KSFB)+ (KSFD) Platform width and thickness	Stanovoye 4	29	14.5 mm		mean width
			25.7 mm		mean thickness
(PPCD) Platform preparation core dorsal	Stanovoye 4	32	5	15.6%	no preparation (0)
			0	0.0%	abrasion (1)
			13	40.6%	trimming (2)
			1	3.1%	trimming and abrasion (3)
			7	21.9%	trimming/abrasion ON platform (4)
			6	18.8%	regular trimming/abrasion + trim/abr ON platform (5)

Table 2. Data set for cores – Focus area 2a.

Local scale						Regional scale				
Attribute	**Site**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**	**Attribute**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**
(KSFA) Platform design	Ljungaviken	10	10	100.0%	one platform (1)	**(KSFA) Platform design**	162	158	97.5%	one platform (1)
			0	0.0%	2 or more, otherwise arranged (5)					
	Rönneholm	21	20	95.2%	one platform (1)					
			1	4.8%	2 or more, otherwise arranged (5)			4	2.5%	2 or more, otherwise arranged (5)
	Tågerup	131	128	97.7%	one platform (1)					
			3	2.3%	2 or more, otherwise arranged (5)					
(KSFN) Platform use	Ljungaviken	10	10	100.0%	one main platform (1)	**(KSFN) Platform use**	158	156	98.7%	one main platform (1)
			0	0.0%	2 equivalent PF, successively (2)					
	Rönneholm	19	18	94.7%	one main platform (1)					
			1	5.3%	2 equivalent PF, successively (2)			2	1.3%	2 equivalent PF, successively (2)
	Tågerup	129	128	99.2%	one main platform (1)					
			1	0.8%	2 equivalent PF, successively (2)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(HCF) Handle core on flake	Ljungaviken	8	5	62.5%	not made on flake (0)	**(HCF) Handle core on flake**	153	124	81.0%	not made on flake (0)
			3	37.5%	made on flake (1)					
	Rönneholm	21	18	85,7%	not made on flake (0)					
			3	14.3%	made on flake (1)			29	19.0%	made on flake (1)
	Tågerup	124	101	81.5%	not made on flake (0)					
			23	18.5%	made on flake (1)					
(KAAN) Core front design	Ljungaviken	10	9	90.0%	one core front (1)	**(KAAN) Core front design**	152	138	90.8%	one core front (1)
			1	10.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Rönneholm	18	17	94.4%	one core front (1)			6	3.9%	2 independent (2)
			1	5.6%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Tågerup	124	112	90.3%	one core front (1)			8	5.3%	2 opposing (3)
			4	3.2%	2 independent (2)					
			8	6,5%	2 opposing (3)					
(KR) Back	Ljungaviken	9	3	33.3%	cortex (1)	**(KR) Back**	139	42	30.2%	cortex (1)
			6	66.7%	preparation negative (3)					
			0	0.0%	one big negative (ventral/ dorsal) (4)					
	Rönneholm	19	6	31.6%	cortex (1)			92	66.2%	preparation negative (3)
			13	68.4%	preparation negative (3)					
			0	0.0%	one big negative (ventral/ dorsal) (4)					
	Tågerup	110	33	30.0%	cortex (1)			4	2.9%	one big negative (ventral/ dorsal) (4)
			73	66.4%	preparation negative (3)					
			4	3.6%	one big negative (ventral/ dorsal) (4)					

Local scale						Regional scale				
Attribute	**Site**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**	**Attribute**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**
(KS1) Side 1	Ljungaviken	9	2	22.2%	cortex (1)	**(KS1) Side 1**	152	19	12.5%	cortex (1)
			1	11.1%	preparation negatives (3)					
			5	55.6%	one big negative (ventral/ dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			62	40.8%	preparation negatives (3)
			0	0.0%	preparation negs + plat prep (7)					
			1	11.1%	one negative + platform prep (8)					
	Rönneholm	19	5	26.3%	cortex (1)			26	17.1%	one big negative (ventral/ dorsal) (4)
			3	15.8%	preparation negatives (3)					
			3	15.8%	one big negative (ventral/ dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			1	0.7%	cortex + platform prep (6)
			8	42.1%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Tågerup	123	12	9.8%	cortex (1)			40	26.3%	preparation negs + plat prep (7)
			57	46.3%	preparation negatives (3)					
			18	14.6%	one big negative (ventral/ dorsal) (4)					
			1	0.8%	cortex + platform prep (6)			3	2.0%	one negative + platform prep (8)
			32	26.0%	preparation negs + plat prep (7)					
			3	2.4%	one negative + platform prep (8)					

Local scale						Regional scale				
Attribute	**Site**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**	**Attribute**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**
(KS2) Side 2	Ljungaviken	10	2	20.0%	cortex (1)	**(KS2) Side 2**	153	17	11.1%	cortex (1)
			2	20.0%	preparation negatives (3)					
			4	40.0%	one big negative (ventral/ dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			72	47.1%	preparation negatives (3)
			2	20.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Rönneholm	20	2	10.0%	cortex (1)			22	14.4%	one big negative (ventral/ dorsal) (4)
			9	45.0%	preparation negatives (3)					
			1	5.0%	one big negative (ventral/ dorsal) (4)					
			1	5.0%	cortex + platform prep (6)			2	1.3%	cortex + platform prep (6)
			7	35.0%	preparation negs + plat prep (7)					
			0	0,0%	one negative + platform prep (8)					
	Tågerup	123	13	10.6%	cortex (1)			37	24.2%	preparation negs + plat prep (7)
			59	48.0%	preparation negatives (3)					
			17	13.8%	one big negative (ventral/ dorsal) (4)					
			1	0.8%	cortex + platform prep (6)			3	2.0%	one negative + platform prep (8)
			30	24.4%	preparation negs + plat prep (7)					
			3	2.4%	one negative + platform prep (8)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(EPANG) Exterior platform angle	Ljungaviken	9	0	0.0%	50	(EPANG) Exterior platform angle	138	0	0.0%	50
			0	0.0%	55					
			0	0.0%	60					
			0	0.0%	65			0	0.0%	55
			0	0.0%	70					
			3	33.3%	75					
			1	11.1%	80			0	0.0%	60
			2	22.2%	85					
			2	22.2%	90					
			0	0.0%	95			4	2.9%	65
			1	11.1%	100					
			0	0.0%	105					
			0	0.0%	110			4	2.9%	70
			0	0.0%	115					
	Rönneholm	15	0	0.0%	50					
			0	0.0%	55			22	15.9%	75
			0	0.0%	60					
			0	0.0%	65					
			1	6.7%	70			17	12.3%	80
			4	26.7%	75					
			3	20.0%	80					
			2	13.3%	85			27	19.6%	85
			3	20.0%	90					
			1	6.7%	95					
			1	6.7%	100			24	17.4%	90
			0	0.0%	105					
			0	0.0%	110					
			0	0.0%	115			19	13.8%	95
	Tågerup	114	0	0.0%	50					
			0	0.0%	55					
			0	0.0%	60			13	9.4%	100
			4	3.5%	65					
			3	2.6%	70					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
			15	13.2%	75			4	2.9%	105
			13	11.4%	80					
			23	20.2%	85					
			19	16.7%	90			2	1.4%	110
			18	15.8%	95					
			11	9.6%	100					
			4	3.5%	105			2	1.4%	115
			2	1.8%	110					
			2	1.8%	115					
(PMORPH) Platform morphology	Ljungaviken	10	4	40.0%	smooth/plain (1)	**(PMORPH) Platform morphology**	160	88	55.0%	smooth/plain (1)
			3	30.0%	faceted platform (2)					
			3	30.0%	partial faceting (3)					
	Rönneholm	23	23	100.0%	smooth/plain (1)			63	39.4%	faceted platform (2)
			0	0.0%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
	Tågerup	127	61	48.0%	smooth/plain (1)			9	5.6%	partial faceting (3)
			60	47.2%	faceted platform (2)					
			6	4.7%	partial faceting (3)					
(KSFB)+ (KSFD) Platform width and thickness	Ljungaviken	10	16.4 mm		mean width	**(KSFB)+ (KSFD) Platform width and thickness**	161	22.25 mm		mean width
			27.2 mm		mean thickness					
	Rönneholm	23	18.9 mm		mean width					
			41.6 mm		mean thickness			48.35 mm		mean thickness
	Tågerup	128	23.3 mm		mean width					
			51.2 mm		mean thickness					

Local scale						Regional scale				
Attribute	**Site**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**	**Attribute**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**
(PPCD) Platform preparation core dorsal	Ljungaviken	12	1	8.3%	no preparation (0)	**(PPCD) Platform preparation core dorsal**	150	10	6.7%	no preparation (0)
			1	8.3%	abrasion (1)					
			4	33.3%	trimming (2)					
			6	50.0%	trimming and abrasion (3)			17	11.3%	abrasion (1)
			0	0.0%	trimming/ abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)					
	Rönneholm	21	5	23.8%	no preparation (0)			79	52.7%	trimming (2)
			1	4.8%	abrasion (1)					
			9	42.9%	trimming (2)					
			6	28.6%	trimming and abrasion (3)			44	29.3%	trimming and abrasion (3)
			0	0.0%	trimming/ abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)					
	Tågerup	117	4	3.4%	no preparation (0)			0	0.0%	trimming/ abrasion ON platform (4)
			15	12.8%	abrasion (1)					
			66	56.4%	trimming (2)					
			32	27.4%	trimming and abrasion (3)			0	0.0%	regular trimming/ abrasion + trim/abr ON platform (5)
			0	0.0%	trimming/ abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)					

Table 3. Data set for cores – Focus area 2b.

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds	(%)	Attribute morphology
(KSFA) Platform design	Dreggers LA 3	22	22	100.0%	one platform (1)	(KSFA) Platform design	30	30	100.0%	one platform (1)
			0	0.0%	2 or more, otherwise arranged (5)					
	Owschlag 183	3	3	100.0%	one platform (1)					
			0	0.0%	2 or more, otherwise arranged (5)			0	0.0%	2 or more, otherwise arranged (5)
	Satrup LA 2	5	5	100.0%	one platform (1)					
			0	0.0%	2 or more, otherwise arranged (5)					
(KSFN) Platform use	Dreggers LA 3	22	22	100.0%	one main platform (1)	(KSFN) Platform use	30	30	100.0%	one main platform (1)
			0	0.0%	2 equivalent PF, successively (2)					
	Owschlag 183	3	3	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)			0	0.0%	2 equivalent PF, successively (2)
	Satrup LA 2	5	5	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)					
(HCF) Handle core on flake	Dreggers LA 3	19	19	100.0%	not made on flake (0)	(HCF) Handle core on flake	22	22	100.0%	not made on flake (0)
			0	0.0%	made on flake (1)					
	Owschlag 183	3	3	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)			0	0.0%	made on flake (1)
	Satrup LA 2	0	0	0.0%	not made on flake (0)					
			0	0.0%	made on flake (1)					
(KAAN) Core front design	Dreggers LA 3	22	21	95.5%	one core front (1)	(KAAN) Core front design	28	27	96.4%	one core front (1)
			1	4.5%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Owschlag 183	2	2	100.0%	one core front (1)			1	3.6%	2 independent (2)
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Satrup LA 2	4	4	100.0%	one core front (1)			0	0.0%	2 opposing (3)
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					

Local scale						Regional scale				
Attribute	**Site**	**Total no. of finds**	**No. of finds/Meas. for metric**	**(%)**	**Attribute morphology**	**Attribute**	**Total no. of finds**	**No. of finds**	**(%)**	**Attribute morphology**
(KR) Back	Dreggers LA 3	17	6	35.3%	cortex (1)	**(KR) Back**	23	7	30.4%	cortex (1)
			11	64.7%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Owschlag 183	2	1	50.0%	cortex (1)			16	69.6%	preparation negative (3)
			1	50.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Satrup LA 2	4	0	0.0%	cortex (1)			0	0.0%	one big negative (ventral/dorsal) (4)
			4	100.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
(KS1) Side 1	Dreggers LA 3	16	1	6.3%	cortex (1)	**(KS1) Side 1**	22	1	4.5%	cortex (1)
			6	37.5%	preparation negatives (3)					
			1	6.3%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			7	31.8%	preparation negatives (3)
			7	43.8%	preparation negs + plat prep (7)					
			1	6.3%	one negative + platform prep (8)					
	Owschlag 183	1	0	0.0%	cortex (1)			3	13.6%	one big negative (ventral/dorsal) (4)
			0	0.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			0	0.0%	cortex + platform prep (6)
			0	0.0%	preparation negs + plat prep (7)					
			1	100.0%	one negative + platform prep (8)					
	Satrup LA 2	5	0	0.0%	cortex (1)			9	40.9%	preparation negs + plat prep (7)
			1	20.0%	preparation negatives (3)					
			2	40.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			2	9.1%	one negative + platform prep (8)
			2	40.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds	(%)	Attribute morphology
(KS2) Side 2	Dreggers LA 3	20	2	10.0%	cortex (1)	(KS2) Side 2	27	2	7.4%	cortex (1)
			4	20.0%	preparation negatives (3)					
			1	5.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			7	25.9%	preparation negatives (3)
			12	60.0%	preparation negs + plat prep (7)					
			1	5.0%	one negative + platform prep (8)					
	Owschlag 183	2	0	0.0%	cortex (1)			2	7.4%	one big negative (ventral/dorsal) (4)
			1	50.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			0	0.0%	cortex + platform prep (6)
			0	0.0%	preparation negs + plat prep (7)					
			1	50.0%	one negative + platform prep (8)					
	Satrup LA 2	5	0	0.0%	cortex (1)			14	51.9%	preparation negs + plat prep (7)
			2	40.0%	preparation negatives (3)					
			1	20.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			2	7.4%	one negative + platform prep (8)
			2	40.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
(EPANG) Exterior platform angle	Dreggers LA 3	45	0	0.0%	50 degrees	(EPANG) Exterior platform angle	50	0	0.0%	50 degrees
			0	0.0%	55 degrees					
			0	0.0%	60 degrees					
			0	0.0%	65 degrees			0	0.0%	55 degrees
			4	8.9%	70 degrees					
			2	4.4%	75 degrees					
			11	24.4%	80 degrees			0	0.0%	60 degrees
			7	15.6%	85 degrees					
			10	22.2%	90 degrees					
			3	6.7%	95 degrees			1	2.0%	65 degrees
			5	11.1%	100 degrees					
			2	4.4%	105 degrees					
			0	0.0%	110 degrees			5	10.0%	70 degrees
			1	2.2%	115 degrees					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds	(%)	Attribute morphology
(EPANG) Exterior platform angle	Owschlag 183	1	0	0.0%	50 degrees	(EPANG) Exterior platform angle	50			
			0	0.0%	55 degrees			2	4.0%	75 degrees
			0	0.0%	60 degrees					
			0	0.0%	65 degrees					
			0	0.0%	70 degrees			12	24.0%	80 degrees
			0	0.0%	75 degrees					
			1	100.0%	80 degrees					
			0	0.0%	85 degrees			8	16.0%	85 degrees
			0	0.0%	90 degrees					
			0	0.0%	95 degrees					
			0	0.0%	100 degrees			11	22.0%	90 degrees
			0	0.0%	105 degrees					
			0	0.0%	110 degrees					
			0	0.0%	115 degrees			3	6.0%	95 degrees
	Satrup LA 2	4	0	0.0%	50 degrees					
			0	0.0%	55 degrees					
			0	0.0%	60 degrees			5	10.0%	100 degrees
			1	25.0%	65 degrees					
			1	25.0%	70 degrees					
			0	0.0%	75 degrees			2	4.0%	105 degrees
			0	0.0%	80 degrees					
			1	25.0%	85 degrees					
			1	25.0%	90 degrees			0	0.0%	110 degrees
			0	0.0%	95 degrees					
			0	0.0%	100 degrees					
			0	0.0%	105 degrees			1	2.0%	115 degrees
			0	0.0%	110 degrees					
			0	0.0%	115 degrees					
(PMORPH) Platform morphology	Dreggers LA 3	53	45	84.9%	smooth/plain (1)	(PMORPH) Platform morphology	60	51	85.0%	smooth/plain (1)
			2	3.8%	faceted platform (2)					
			6	11.3%	partial faceting (3)					
	Owschlag 183	1	1	100.0%	smooth/plain (1)			3	5.0%	faceted platform (2)
			0	0.0%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
	Satrup LA 2	6	5	83.3%	smooth/plain (1)			6	10.0%	partial faceting (3)
			1	16.7%	faceted platform (2)					
			0	0.0%	partial faceting (3)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds	(%)	Attribute morphology
(KSFB)+ (KSFD) Platform width and thickness	Dreggers LA 3	x	x		mean width	(KSFB)+ (KSFD) Platform width and thickness	5	x	x	x
			x		mean thickness					
	Owschlag 183	x	x		mean width					
			x		mean thickness					
	Satrup LA 2	5	30.8 mm		mean width					
			47.4 mm		mean thickness					
(PPCD) Platform preparation core dorsal	Dreggers LA 3	53	6	11.3%	no preparation (0)	(PPCD) Platform preparation core dorsal	59	6	10.2%	no preparation (0)
			0	0.0%	abrasion (1)					
			46	86.8%	trimming (2)					
			1	1.9%	trimming and abrasion (3)			1	1.7%	abrasion (1)
			0	0.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)					
	Owschlag 183	1	0	0.0%	no preparation (0)			49	83.1%	trimming (2)
			0	0.0%	abrasion (1)					
			0	0.0%	trimming (2)					
			1	100.0%	trimming and abrasion (3)			3	5.1%	trimming and abrasion (3)
			0	0.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)					
	Satrup LA 2	5	0	0.0%	no preparation (0)			0	0.0%	trimming/abrasion ON platform (4)
			1	20.0%	abrasion (1)					
			3	60.0%	trimming (2)					
			1	20.0%	trimming and abrasion (3)			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)
			0	0.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)					

Table 4. Data set for cores – Focus area 3.

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KSFA) Platform design	Krøgenes D2	6	6	100.0%	one platform (1)	(KSFA) Platform design	75	74		one platform (1)
			0	0.0%	2 or more, otherwise arranged (5)					
	Lokalitet 3 – Halden	54	53	98.1%	one platform (1)					
			1	1.9%	2 or more, otherwise arranged (5)					
	Stene terrasse	3	3	100.0%	one platform (1)					
			0	0.0%	2 or more, otherwise arranged (5)			1	1.3%	2 or more, otherwise arranged (5)
	Stokke/Polland 8	5	5	100.0%	one platform (1)					
			0	0.0%	2 or more, otherwise arranged (5)					
	Vallermyrene 4	7	7	100.0%	one platform (1)					
			0	0.0%	2 or more, otherwise arranged (5)					
(KSFN) Platform use	Krøgenes D2	6	6	100.0%	one main platform (1)	(KSFN) Platform use	67	66	98.5%	one main platform (1)
			0	0.0%	2 equivalent PF, successively (2)					
	Lokalitet 3 – Halden	46	45	97.8%	one main platform (1)					
			1	2.2%	2 equivalent PF, successively (2)					
	Stene terrasse	3	3	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)			1	1.5%	2 equivalent PF, successively (2)
	Stokke/Polland 8	5	5	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)					
	Vallermyrene 4	7	7	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)					
(HCF) Handle core on flake	Krøgenes D2	6	4	66.7%	not made on flake (0)	(HCF) Handle core on flake	73	68	93.2%	not made on flake (0)
			2	33.3%	made on flake (1)					
	Lokalitet 3 – Halden	54	52	96.3%	not made on flake (0)					
			2	3.7%	made on flake (1)					
	Stene terrasse	2	2	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)			5	6.8%	made on flake (1)
	Stokke/Polland 8	4	3	75.0%	not made on flake (0)					
			1	25.0%	made on flake (1)					
	Vallermyrene 4	7	7	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KAAN) Core front design	Krøgenes D2	6	6	100.0%	one core front (1)	(KAAN) Core front design	61	59	96.7%	one core front (1)
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Lokalitet 3 – Halden	46	44	95.7%	one core front (1)					
			1	2.2%	2 independent (2)					
			1	2.2%	2 opposing (3)			1	1.6%	2 independent (2)
	Stene terrasse	2	2	100.0%	one core front (1)					
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Stokke/Polland 8	4	4	100.0%	one core front (1)					
			0	0.0%	2 independent (2)			1	1.6%	2 opposing (3)
			0	0.0%	2 opposing (3)					
	Vallermyrene 4	3	3	100.0%	one core front (1)					
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
(KR) Back	Krøgenes D2	6	2	33.3%	cortex (1)	(KR) Back	54	12	22.2%	cortex (1)
			4	66.7%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Lokalitet 3 – Halden	41	9	22.0%	cortex (1)					
			32	78.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)			42	77.8%	preparation negative (3)
	Stene terrasse	2	0	0.0%	cortex (1)					
			2	100.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Stokke/Polland 8	2	1	50.0%	cortex (1)					
			1	50.0%	preparation negative (3)			0	0.0%	one big negative (ventral/dorsal) (4)
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Vallermyrene 4	3	0	0.0%	cortex (1)					
			3	100.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KS1) Side 1	Krøgenes D2	6	2	33.3%	cortex (1)	(KS1) Side 1	62	5	8.1%	cortex (1)
			2	33.3%	preparation negatives (3)					
			1	16.7%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			1	16.7%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)			26	41.9%	preparation negatives (3)
	Lokalitet 3 – Halden	43	2	4.7%	cortex (1)					
			19	44.2%	preparation negatives (3)					
			7	16.3%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			14	32.6%	preparation negs + plat prep (7)			8	12.9%	one big negative (ventral/dorsal) (4)
			1	2.3%	one negative + platform prep (8)					
	Stene terrasse	3	1	33.3%	cortex (1)					
			1	33.3%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			0	0.0%	cortex + platform prep (6)
			1	33.3%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Stokke/Polland 8	3	0	0.0%	cortex (1)					
			3	100.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)			22	35.5%	preparation negs + plat prep (7)
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Vallermyrene 4	7	0	0.0%	cortex (1)					
			1	14.3%	preparation negatives (3)			1	1.6%	one negative + platform prep (8)
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			6	85.7%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					

Local scale						Regional scale				
Attribute	**Site**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**	**Attribute**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**
(KS1) Side 2	Krøgenes D2	6	1	16.7%	cortex (1)	**(KS1) Side 2**	62	3	4.8%	cortex (1)
			3	50.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			1	16.7%	cortex + platform prep (6)					
			1	16.7%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)			24	38.7%	preparation negatives (3)
	Lokalitet 3 – Halden	43	1	2.3%	cortex (1)					
			16	37.2%	preparation negatives (3)					
			5	11.6%	one big negative (ventral/dorsal) (4)					
			1	2.3%	cortex + platform prep (6)					
			19	44.2%	preparation negs + plat prep (7)			6	9.7%	one big negative (ventral/dorsal) (4)
			1	2.3%	one negative + platform prep (8)					
	Stene terrasse	3	0	0.0%	cortex (1)					
			0	0.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			2	3.2%	cortex + platform prep (6)
			2	66.7%	preparation negs + plat prep (7)					
			1	33.3%	one negative + platform prep (8)					
	Stokke/Polland 8	3	0	0.0%	cortex (1)					
			2	66.7%	preparation negatives (3)					
			1	33.3%	one big negative (ventral/dorsal) (4)			25	40.3%	preparation negs + plat prep (7)
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Vallermyrene 4	7	1	14.3%	cortex (1)					
			3	42.9%	preparation negatives (3)			2	3.2%	one negative + platform prep (8)
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			3	42.9%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(EPANG) Exterior platform angle	Krøgenes D2	4	0	0.0%	50 degrees	(EPANG) Exterior platform angle	55	1	1.8%	50 degrees
			0	0.0%	55 degrees					
			0	0.0%	60 degrees					
			0	0.0%	65 degrees					
			1	25.0%	70 degrees					
			0	0.0%	75 degrees			0	0.0%	55 degrees
			0	0.0%	80 degrees					
			2	50.0%	85 degrees					
			0	0.0%	90 degrees					
			1	25.0%	95 degrees					
			0	0.0%	100 degrees			2	3.6%	60 degrees
			0	0.0%	105 degrees					
			0	0.0%	110 degrees					
			0	0.0%	115 degrees					
	Lokalitet 3 – Halden	41	0	0.0%	50 degrees					
			0	0.0%	55 degrees			8	14.5%	65 degrees
			2	4.9%	60 degrees					
			6	14.6%	65 degrees					
			2	4.9%	70 degrees					
			8	19.5%	75 degrees					
			5	12.2%	80 degrees			3	5.5%	70 degrees
			6	14.6%	85 degrees					
			5	12.2%	90 degrees					
			6	14.6%	95 degrees					
			1	2.4%	100 degrees					
			0	0.0%	105 degrees			10	18.2%	75 degrees
			0	0.0%	110 degrees					
			0	0.0%	115 degrees					
	Stene terrasse	2	0	0.0%	50 degrees					
			0	0.0%	55 degrees					
			0	0.0%	60 degrees			6	10.9%	80 degrees
			0	0.0%	65 degrees					
			0	0.0%	70 degrees					
			0	0.0%	75 degrees					
			0	0.0%	80 degrees					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
			1	50.0%	85 degrees			10	18.2%	85 degrees
			1	50.0%	90 degrees					
			0	0.0%	95 degrees					
			0	0.0%	100 degrees					
			0	0.0%	105 degrees					
			0	0.0%	110 degrees			6	10.9%	90 degrees
			0	0.0%	115 degrees					
	Stokke/Polland 8	4	0	0.0%	50 degrees					
			0	0.0%	55 degrees					
			0	0.0%	60 degrees					
			1	25.0%	65 degrees			8	14.5%	95 degrees
			0	0.0%	70 degrees					
			1	25.0%	75 degrees					
			0	0.0%	80 degrees					
			1	25.0%	85 degrees					
			0	0.0%	90 degrees			1	1.8%	100 degrees
			1	25.0%	95 degrees					
			0	0.0%	100 degrees					
			0	0.0%	105 degrees					
			0	0.0%	110 degrees					
			0	0.0%	115 degrees			0	0.0%	105 degrees
	Vallermyrene 4	4	1	25.0%	50 degrees					
			0	0.0%	55 degrees					
			0	0.0%	60 degrees					
			1	25.0%	65 degrees					
			0	0.0%	70 degrees			0	0.0%	110 degrees
			1	25.0%	75 degrees					
			1	25.0%	80 degrees					
			0	0.0%	85 degrees					
			0	0.0%	90 degrees					
			0	0.0%	95 degrees			0	0.0%	115 degrees
			0	0.0%	100 degrees					
			0	0.0%	105 degrees					
			0	0.0%	110 degrees					
			0	0.0%	115 degrees					

Local scale						Regional scale				
Attribute	**Site**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**	**Attribute**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**
(PMORPH) Platform morphology	Krøgenes D2	6	3	50.0%	smooth/plain (1)	**(PMORPH) Platform morphology**	73	48	65.8%	smooth/plain (1)
			2	33.3%	faceted platform (2)					
			1	16.7%	partial faceting (3)					
	Lokalitet 3 – Halden	50	37	74.0%	smooth/plain (1)					
			11	22.0%	faceted platform (2)					
			2	4.0%	partial faceting (3)			19	26.0%	faceted platform (2)
	Stene terrasse	3	2	66.7%	smooth/plain (1)					
			1	33.3%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
	Stokke/Polland 8	5	1	20.0%	smooth/plain (1)					
			3	60.0%	faceted platform (2)			6	8.2%	partial faceting (3)
			1	20.0%	partial faceting (3)					
	Vallermyrene 4	9	5	55.6%	smooth/plain (1)					
			2	22.2%	faceted platform (2)					
			2	22.2%	partial faceting (3)					
(KSFB)+ (KSFD) Platform width and thickness	Krøgenes D2	6	17.7 mm		mean width	**(KSFB)+ (KSFD) Platform width and thickness**	73	15.15 mm		mean width
			33.7 mm		mean thickness					
	Lokalitet 3 – Halden	50	17.0 mm		mean width					
			26.2 mm		mean thickness					
	Stene terrasse	3	22.3 mm		mean width					
			30.9 mm		mean thickness			28.91 mm		mean thickness
	Stokke/Polland 8	5	20.2 mm		mean width					
			38.0 mm		mean thickness					
	Vallermyrene 4	9	22.1 mm		mean width					
			35.2 mm		mean thickness					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(PPCD) Platform preparation core dorsal	Krøgenes D2	6	1	16.7%	no preparation (0)	(PPCD) Platform preparation core dorsal	64	8	12.5%	no preparation (0)
			0	0.0%	abrasion (1)					
			5	83.3%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			0	0.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)			1	1.6%	abrasion (1)
	Lokalitet 3 – Halden	46	4	8.7%	no preparation (0)					
			1	2.2%	abrasion (1)					
			40	87.0%	trimming (2)					
			1	2.2%	trimming and abrasion (3)					
			0	0.0%	trimming/abrasion ON platform (4)			54	84.4%	trimming (2)
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)					
	Stene terrasse	2	0	0.0%	no preparation (0)					
			0	0.0%	abrasion (1)					
			2	100.0%	trimming (2)					
			0	0.0%	trimming and abrasion (3)			1	1.6%	trimming and abrasion (3)
			0	0.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)					
	Stokke/Polland 8	4	3	75.0%	no preparation (0)					
			0	0.0%	abrasion (1)					
			1	25.0%	trimming (2)			0	0.0%	trimming/abrasion ON platform (4)
			0	0.0%	trimming and abrasion (3)					
			0	0.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)					
	Vallermyrene 4	6	0	0.0%	no preparation (0)					
			0	0.0%	abrasion (1)			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)
			6	100.0%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			0	0.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/abr ON platform (5)					

Table 5. Data set for cores – Focus area 4.

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KSFA) Platform design	Dubiciai 1	1	1	100.0%	one platform (1)	(KSFA) Platform design	47	43	91.5%	one platform (1)
			0	0.0%	2 opposing platforms (2)					
			0	0.0%	2 or more, otherwise arranged (5)					
	Dusia 8	1	1	100.0%	one platform (1)					
			0	0.0%	2 opposing platforms (2)					
			0	0.0%	2 or more, otherwise arranged (5)					
	Gribasa 4	1	1	100.0%	one platform (1)					
			0	0.0%	2 opposing platforms (2)					
			0	0.0%	2 or more, otherwise arranged (5)					
	Kabeliai 1	1	1	100.0%	one platform (1)					
			0	0.0%	2 opposing platforms (2)					
			0	0.0%	2 or more, otherwise arranged (5)			1	2.1%	2 opposing platforms (2)
	Katra 1	6	6	100.0%	one platform (1)					
			0	0.0%	2 opposing platforms (2)					
			0	0.0%	2 or more, otherwise arranged (5)					
	Maksimonys 4	2	2	100.0%	one platform (1)					
			0	0.0%	2 opposing platforms (2)					
			0	0.0%	2 or more, otherwise arranged (5)					
	Margiai 1	17	14	82.4%	one platform (1)					
			0	0.0%	2 opposing platforms (2)					
			3	17.6%	2 or more, otherwise arranged (5)					
	Margiai 2	7	7	100.0%	one platform (1)			3	6.4%	2 or more, otherwise arranged (5)
			0	0.0%	2 opposing platforms (2)					
			0	0.0%	2 or more, otherwise arranged (5)					
	Netiesai 1	9	8	88.9%	one platform (1)					
			1	11.1%	2 opposing platforms (2)					
			0	0.0%	2 or more, otherwise arranged (5)					
	Papiskes 4	1	1	100.0%	one platform (1)					
			0	0.0%	2 opposing platforms (2)					
			0	0.0%	2 or more, otherwise arranged (5)					
	Varene 2	1	1	100.0%	one platform (1)					
			0	0.0%	2 opposing platforms (2)					
			0	0.0%	2 or more, otherwise arranged (5)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KSFN) Platform use	Dubiciai 1	1	1	100.0%	one main platform (1)	(KSFN) Platform use	47	43	91.5%	one main platform (1)
			0	0.0%	2 equivalent PF, successively (2)					
	Dusia 8	1	1	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)					
	Gribasa 4	1	1	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)					
	Kabeliai 1	1	1	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)					
	Katra 1	6	6	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)					
	Maksimonys 4	2	2	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)			4	8.5%	2 equivalent PF, successively (2)
	Margiai 1	17	14	82.4%	one main platform (1)					
			3	17.6%	2 equivalent PF, successively (2)					
	Margiai 2	7	7	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)					
	Netiesai 1	9	8	88.9%	one main platform (1)					
			1	11.1%	2 equivalent PF, successively (2)					
	Papiskes 4	1	1	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)					
	Varene 2	1	1	100.0%	one main platform (1)					
			0	0.0%	2 equivalent PF, successively (2)					
(HCF) Handle core on flake	Dubiciai 1	1	1	100.0%	not made on flake (0)	(HCF) Handle core on flake	47	45	95.7%	not made on flake (0)
			0	0.0%	made on flake (1)					
	Dusia 8	1	1	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)					
	Gribasa 4	1	1	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)					
	Kabeliai 1	1	1	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)					
	Katra 1	6	6	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)					
	Maksimonys 4	2	2	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)			2	4.3%	made on flake (1)
	Margiai 1	17	17	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)					
	Margiai 2	7	6	85.7%	not made on flake (0)					
			1	14.3%	made on flake (1)					
	Netiesai 1	9	8	88.9%	not made on flake (0)					
			1	11.1%	made on flake (1)					
	Papiskes 4	1	1	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)					
	Varene 2	1	1	100.0%	not made on flake (0)					
			0	0.0%	made on flake (1)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KAAN) Core front design	Dubiciai 1	1	1	100.0%	one core front (1)	(KAAN) Core front design	47	44	93.6%	one core front (1)
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Dusia 8	1	1	100.0%	one core front (1)					
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Gribasa 4	1	1	100.0%	one core front (1)					
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Kabeliai 1	1	1	100.0%	one core front (1)					
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Katra 1	6	6	100.0%	one core front (1)			3	6.4%	2 independent (2)
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Maksimonys 4	2	2	100.0%	one core front (1)					
			0	0.0%	2 independent (2)					
			0	0,0%	2 opposing (3)					
	Margiai 1	17	14	82.4%	one core front (1)					
			3	17.6%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Margiai 2	7	7	100.0%	one core front (1)			0	0.0%	2 opposing (3)
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Netiesai 1	9	9	100.0%	one core front (1)					
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Papiskes 4	1	1	100.0%	one core front (1)					
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					
	Varene 2	1	1	100.0%	one core front (1)					
			0	0.0%	2 independent (2)					
			0	0.0%	2 opposing (3)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KR) Core back	Dubiciai 1	1	0	0.0%	cortex (1)	(KR) Core back	43	23	53.5%	cortex (1)
			1	100.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Dusia 8	1	1	100.0%	cortex (1)					
			0	0.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Gribasa 4	1	1	100.0%	cortex (1)					
			0	0.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Kabeliai 1	1	0	0.0%	cortex (1)					
			1	100.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)			20	46.5%	preparation negative (3)
	Katra 1	5	4	80.0%	cortex (1)					
			1	20.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Maksimonys 4	2	1	50.0%	cortex (1)					
			1	50.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Margiai 1	14	8	57.1%	cortex (1)					
			6	42.9%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Margiai 2	7	4	57.1%	cortex (1)					
			3	42.9%	preparation negative (3)			0	0.0%	one big negative (ventral/ dorsal) (4)
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Netiesai 1	9	4	44.4%	cortex (1)					
			5	55.6%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Papiskes 4	1	0	0.0%	cortex (1)					
			1	100.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
	Varene 2	1	0	0.0%	cortex (1)					
			1	100.0%	preparation negative (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KS1) Core side 1	Dubiciai 1	1	0	0.0%	cortex (1)	**(KS1) Core side 1**	44	8	18.2%	cortex (1)
			1	100.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Dusia 8	1	1	100.0%	cortex (1)					
			0	0.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)			25	56.8%	preparation negatives (3)
	Gribasa 4	1	0	0.0%	cortex (1)					
			1	100.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Kabeliai 1	1	0	0.0%	cortex (1)					
			1	100.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)			5	11.4%	one big negative (ventral/ dorsal) (4)
			0	0.0%	one negative + platform prep (8)					
	Katra 1	5	1	20.0%	cortex (1)					
			1	20.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			1	20.0%	cortex + platform prep (6)					
			2	40.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Maksimonys 4	2	0	0.0%	cortex (1)					
			1	50.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			1	2.3%	cortex + platform prep (6)
			1	50.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KS1) Core side 1	Margiai 1	16	3	18.8%	cortex (1)	(KS1) Core side 1				
			9	56.3%	preparation negatives (3)					
			2	12.5%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			1	6.3%	preparation negs + plat prep (7)					
			1	6.3%	one negative + platform prep (8)					
	Margiai 2	7	0	0.0%	cortex (1)					
			4	57.1%	preparation negatives (3)					
			3	42.9%	one big negative (ventral/dorsal) (4)			4	9.1%	preparation negs + plat prep (7)
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Netiesai 1	8	3	37.5%	cortex (1)					
			5	62.5%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Papiskes 4	1	0	0.0%	cortex (1)					
			1	100.0%	preparation negatives (3)			1	2.3%	one negative + platform prep (8)
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Varene 2	1	0	0.0%	cortex (1)					
			1	100.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KS2) Core side 2	Dubiciai 1	1	0	0.0%	cortex (1)	(KS2) Core side 2	45	9	20.0%	cortex (1)
			1	100.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Dusia 8	1	1	100.0%	cortex (1)					
			0	0.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Gribasa 4	1	0	0.0%	cortex (1)			23	51.1%	preparation negatives (3)
			1	100.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Kabeliai 1	1	0	0.0%	cortex (1)					
			0	0.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			1	100.0%	preparation negs + plat prep (7)			8	17.8%	one big negative (ventral/ dorsal) (4)
			0	0.0%	one negative + platform prep (8)					
	Katra 1	5	1	20.0%	cortex (1)					
			3	60.0%	preparation negatives (3)					
			1	20.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Maksimonys 4	2	0	0.0%	cortex (1)					
			2	100.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)			0	0.0%	cortex + platform prep (6)
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(KS2) Core side 2	Margiai 1	16	4	25.0%	cortex (1)	(KS2) Core side 2				
			8	50.0%	preparation negatives (3)					
			3	18.8%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			1	6.3%	one negative + platform prep (8)					
	Margiai 2	7	0	0.0%	cortex (1)					
			3	42.9%	preparation negatives (3)					
			2	28.6%	one big negative (ventral/dorsal) (4)			3	6.7%	preparation negs + plat prep (7)
			0	0.0%	cortex + platform prep (6)					
			1	14.3%	preparation negs + plat prep (7)					
			1	14.3%	one negative + platform prep (8)					
	Netiesai 1	9	2	22.2%	cortex (1)					
			4	44.4%	preparation negatives (3)					
			2	22.2%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			1	11.1%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Papiskes 4	1	0	0.0%	cortex (1)					
			1	100.0%	preparation negatives (3)			2	4.4%	one negative + platform prep (8)
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
	Varene 2	1	1	100.0%	cortex (1)					
			0	0.0%	preparation negatives (3)					
			0	0.0%	one big negative (ventral/dorsal) (4)					
			0	0.0%	cortex + platform prep (6)					
			0	0.0%	preparation negs + plat prep (7)					
			0	0.0%	one negative + platform prep (8)					
(EPANG) Exterior platform angle	Dubiciai 1	1	0	0.0%	50	(EPANG) Exterior platform angle	43	0	0.0%	50
			0	0.0%	55					
			0	0.0%	60					
			0	0.0%	65					
			0	0.0%	70					
			0	0.0%	75					
			1	100.0%	80					
			0	0.0%	85					
			0	0.0%	90					
			0	0.0%	95					
			0	0.0%	100					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
			0	0.0%	105			0	0.0%	55
			0	0.0%	110					
			0	0.0%	115					
	Dusia 8	1	0	0.0%	50					
			0	0.0%	55					
			0	0.0%	60					
			0	0.0%	65					
			0	0.0%	70					
			0	0.0%	75					
			0	0.0%	80					
			0	0.0%	85					
			1	100.0%	90			0	0.0%	60
			0	0.0%	95					
			0	0.0%	100					
			0	0.0%	105					
			0	0.0%	110					
			0	0.0%	115					
	Gribasa 4	1	0	0.0%	50					
			0	0.0%	55					
			0	0.0%	60					
			0	0.0%	65					
			0	0.0%	70					
			0	0.0%	75			0	0.0%	65
			0	0.0%	80					
			1	100.0%	85					
			0	0.0%	90					
			0	0.0%	95					
			0	0.0%	100					
			0	0.0%	105					
			0	0.0%	110					
			0	0.0%	115					
	Kabeliai 1	1	0	0.0%	50					
			0	0.0%	55					
			0	0.0%	60			3	7.0%	70
			0	0.0%	65					
			0	0.0%	70					
			1	100.0%	75					
			0	0.0%	80					
			0	0.0%	85					
			0	0.0%	90					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
			0	0.0%	95					
			0	0.0%	100					
			0	0.0%	105					
			0	0.0%	110					
			0	0.0%	115			5	11.6%	75
	Katra 1	5	0	0.0%	50					
			0	0.0%	55					
			0	0.0%	60					
			0	0.0%	65					
			1	20.0%	70					
			1	20.0%	75					
			1	20.0%	80					
			1	20.0%	85					
			1	20.0%	90					
			0	0.0%	95					
			0	0.0%	100			9	20.9%	80
			0	0.0%	105					
			0	0.0%	110					
			0	0.0%	115					
	Maksimonys 4	2	0	0.0%	50					
			0	0.0%	55					
			0	0.0%	60					
			0	0.0%	65					
			0	0.0%	70					
			0	0.0%	75					
			0	0.0%	80					
			2	100.0%	85			10	23.3%	85
			0	0.0%	90					
			0	0.0%	95					
			0	0.0%	100					
			0	0.0%	105					
			0	0.0%	110					
			0	0.0%	115					
	Margiai 1	16	0	0.0%	50					
			0	0.0%	55					
			0	0.0%	60					
			0	0.0%	65					
			2	12.5%	70			7	16.3%	90
			0	0.0%	75					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
			7	43.8%	80					
			3	18.8%	85					
			0	0.0%	90					
			3	18.8%	95					
			0	0.0%	100					
			1	6.3%	105					
			0	0.0%	110					
			0	0.0%	115					
	Margiai 2	6	0	0.0%	50					
			0	0.0%	55			7	16.3%	95
			0	0.0%	60					
			0	0.0%	65					
			0	0.0%	70					
			2	33.3%	75					
			0	0.0%	80					
			1	16.7%	85					
			2	33.3%	90					
			1	16.7%	95					
			0	0.0%	100					
			0	0.0%	105					
			0	0.0%	110			1	2.3%	100
			0	0.0%	115					
	Netiesai 1	8	0	0.0%	50					
			0	0.0%	55					
			0	0.0%	60					
			0	0.0%	65					
			0	0.0%	70					
			1	12.5%	75					
			0	0.0%	80					
			2	25.0%	85					
			2	25.0%	90					
			2	25.0%	95			1	2.3%	105
			1	12.5%	100					
			0	0.0%	105					
			0	0.0%	110					
			0	0.0%	115					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
	Papiskes 4	1	0	0.0%	50					
			0	0.0%	55					
			0	0.0%	60					
			0	0.0%	65					
			0	0.0%	70					
			0	0.0%	75					
			0	0.0%	80			0	0.0%	110
			0	0.0%	85					
			0	0.0%	90					
			1	100.0%	95					
			0	0.0%	100					
			0	0.0%	105					
			0	0.0%	110					
			0	0.0%	115					
	Varene 2	1	0	0.0%	50					
			0	0.0%	55					
			0	0.0%	60					
			0	0.0%	65			0	0.0%	115
			0	0.0%	70					
			0	0.0%	75					
			0	0.0%	80					
			0	0.0%	85					
			1	100.0%	90					
			0	0.0%	95					
			0	0.0%	100					
			0	0.0%	105					
			0	0.0%	110					
			0	0.0%	115					
(PMORPH) Platform morphology	Dubiciai 1	1	0	0.0%	smooth/plain (1)	(PMORPH) Platform morphology	52	9	17.3%	smooth/plain (1)
			1	100.0%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
	Dusia 8	1	0	0.0%	smooth/plain (1)					
			1	100.0%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
	Gribasa 4	1	0	0.0%	smooth/plain (1)					
			1	100.0%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
	Kabeliai 1	1	0	0.0%	smooth/plain (1)					
			1	100.0%	faceted platform (2)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
			0	0.0%	partial faceting (3)			39	75.0%	faceted platform (2)
	Katra 1	6	1	16.7%	smooth/plain (1)					
			4	66.7%	faceted platform (2)					
			3	50.0%	partial faceting (3)					
	Maksimonys 4	2	1	50.0%	smooth/plain (1)					
			0	0.0%	faceted platform (2)					
			1	50.0%	partial faceting (3)					
	Margiai 1	19	5	26.3%	smooth/plain (1)					
			14	73.7%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
	Margiai 2	7	0	0.0%	smooth/plain (1)			4	7.7%	partial faceting (3)
			7	100.0%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
	Netiesai 1	10	2	20.0%	smooth/plain (1)					
			8	80.0%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
	Papiskes 4	1	0	0.0%	smooth/plain (1)					
			1	100.0%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
	Varene 2	1	0	0.0%	smooth/plain (1)					
			1	100.0%	faceted platform (2)					
			0	0.0%	partial faceting (3)					
(KSFB)+ (KSFD) Platform width and thickness	Dubiciai 1	1	18.9 mm		mean width	(KSFB)+ (KSFD) Platform width and thickness	50	25,89		mean width
			32.4 mm		mean thickness					
	Dusia 8	1	31.8 mm		mean width					
			36.7 mm		mean thickness					
	Gribasa 4	1	26.8 mm		mean width					
			36.6 mm		mean thickness					
	Kabeliai 1	1	26.5 mm		mean width					
			49.5 mm		mean thickness					
	Katra 1	6	25.17 mm		mean width					
			37.72 mm		mean thickness					
	Maksimonys 4	2	30.6 mm		mean width					
			49.75 mm		mean thickness			37,64		mean thickness
	Margiai 1	19	24.53 mm		mean width					
			34.05 mm		mean thickness					
	Margiai 2	7	28.14 mm		mean width					
			34.94 mm		mean thickness					
	Netiesai 1	10	26.02 mm		mean width					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
			40.84 mm		mean thickness					
	Papiskes 4	1	26.5 mm		mean width					
			42.5 mm		mean thickness					
	Varene 2	1	28.7 mm		mean width					
			58.7 mm		mean thickness					
(PPCD) Platform preparation core dorsal	Dubiciai 1	1	0	0.0%	no preparation (0)	(PPCD) Platform preparation core dorsal	49	4	8.2%	no preparation (0)
			0	0.0%	abrasion (1)					
			0	0.0%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			0	0.0%	trimming/abrasion ON platform (4)					
			1	100.0%	regular trimming/abrasion + trim/ abr ON platform (5)					
	Dusia 8	1	0	0.0%	no preparation (0)					
			0	0.0%	abrasion (1)					
			0	0.0%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			1	100.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/ abr ON platform (5)			1	2.0%	abrasion (1)
	Gribasa 4	1	0	0.0%	no preparation (0)					
			0	0.0%	abrasion (1)					
			1	100.0%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			0	0.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/ abr ON platform (5)					
	Kabeliai 1	1	0	0.0%	no preparation (0)					
			0	0.0%	abrasion (1)					
			0	0.0%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			1	100.0%	trimming/abrasion ON platform (4)			19	38.8%	trimming (2)
			0	0.0%	regular trimming/abrasion + trim/ abr ON platform (5)					
	Katra 1	6	0	0.0%	no preparation (0)					
			1	16.7%	abrasion (1)					
			0	0.0%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			3	50.0%	trimming/abrasion ON platform (4)					
			2	33.3%	regular trimming/abrasion + trim/ abr ON platform (5)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
	Maksimonys 4	2	0	0.0%	no preparation (0)					
			0	0.0%	abrasion (1)					
			0	0.0%	trimming (2)					
			0	0.0%	trimming and abrasion (3)			0	0.0%	trimming and abrasion (3)
			1	50.0%	trimming/abrasion ON platform (4)					
			1	50.0%	regular trimming/abrasion + trim/ abr ON platform (5)					
	Margiai 1	19	3	15.8%	no preparation (0)					
			0	0.0%	abrasion (1)					
			9	47.4%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			4	21.1%	trimming/abrasion ON platform (4)					
			3	15.8%	regular trimming/abrasion + trim/ abr ON platform (5)					
	Margiai 2	7	0	0.0%	no preparation (0)					
			0	0.0%	abrasion (1)					
			2	28.6%	trimming (2)			14	28.6%	trimming/abrasion ON platform (4)
			0	0.0%	trimming and abrasion (3)					
			2	28.6%	trimming/abrasion ON platform (4)					
			3	42.9%	regular trimming/abrasion + trim/ abr ON platform (5)					
	Netiesai 1	9	1	11.1%	no preparation (0)					
			0	0.0%	abrasion (1)					
			6	66.7%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			1	11.1%	trimming/abrasion ON platform (4)					
			1	11.1%	regular trimming/abrasion + trim/ abr ON platform (5)					
	Papiskes 4	1	0	0.0%	no preparation (0)			11	22.4%	regular trimming/abrasion + trim/abr ON platform (5)
			0	0.0%	abrasion (1)					
			0	0.0%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			1	100.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/ abr ON platform (5)					
	Varene 2	1	0	0.0%	no preparation (0)					
			0	0.0%	abrasion (1)					
			1	100.0%	trimming (2)					
			0	0.0%	trimming and abrasion (3)					
			0	0.0%	trimming/abrasion ON platform (4)					
			0	0.0%	regular trimming/abrasion + trim/ abr ON platform (5)					

Table 6. Data set for cores – Grądy Woniecko.

Local scale					
Attribute	**Site**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**
(KSFA) Platform design	Grądy-Woniecko	5	5		one platform (1)
			0		2, opposing (2)
			0		2 or more, otherwise arranged (5)
(KSFN) Platform use	Grądy-Woniecko	5	5		one main platform (1)
			0		2 equivalent PF, successively (2)
(HCF) Handle core on flake	Grądy-Woniecko	5	2		not made on flake (0)
			3		made on flake (1)
(KAAN) Core front design	Grądy-Woniecko	5	2		one core front (1)
			0		2 independent (2)
			3		2 opposing (3)
(KR) Back	Grądy-Woniecko	5	3		not available (0)
			1		cortex (1)
			1		preparation negative (3)
			0		one big negative (ventral/dorsal) (4)
(KS1) Side 1	Grądy-Woniecko	5	0		cortex (1)
			2		preparation negatives (3)
			0		one big negative (ventral/dorsal) (4)
			1		cortex + platform prep (6)
			1		preparation negs + plat prep (7)
			1		one negative + platform prep (8)
(KS2) Side 2	Grądy-Woniecko	5	0		cortex (1)
			1		preparation negatives (3)
			1		one big negative (ventral/dorsal) (4)
			0		cortex + platform prep (6)
			1		preparation negs + plat prep (7)
			2		one negative + platform prep (8)
(EPANG) Exterior platform angle	Grądy-Woniecko	8	0		50 degrees
			2		55 degrees
			0		60 degrees
			1		65 degrees
			1		70 degrees
			3		75 degrees
			0		80 degrees
			1		85 degrees
			0		90 degrees
			0		95 degrees

Local scale					
Attribute	**Site**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**
			0		100 degrees
			0		105 degrees
			0		110 degrees
			0		115 degrees
(PMORPH) Platform morphology	Grądy-Woniecko	5	4		smooth/plain (1)
			0		faceted platform (2)
			1		partial faceting (3)
(KSFB)+ (KSFD) Platform width and thickness	Grądy-Woniecko	5	27.7 mm		mean width
			65 mm		mean thickness
(PPCD) Platform preparation core dorsal	Grądy-Woniecko	8	1		no preparation (0)
			1		abrasion (1)
			3		trimming (2)
			3		trimming and abrasion (3)
			0		trimming/abrasion ON platform (4)
			0		regular trimming/abrasion + trim/abr ON platform (5)

2 Data sets for blades

Table 7. Data set for blades – Focus area 2a.

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(DBF) Dorsal blade face	Ljungaviken	18	0	0%	dorsal cortex (1)	(DBF) Dorsal blade face	628	1	0.2%	dorsal cortex (1)
			0	0%	2 dorsal faces, 1 cortex (2)					
			0	0%	3 dorsal faces, 1 cortex (3)					
			10	56%	2 dorsal faces (4)			13	2.1%	2 dorsal faces, 1 cortex (2)
			8	44%	3 dorsal faces (5)					
			0	0%	multi dorsal faces (6)					
			0	0%	bilaterally crested blade (7)			5	0.8%	3 dorsal faces, 1 cortex (3)
			0	0%	2 dorsal faces, 1 crest (8)					
			0	0%	3 dorsal faces, 1 crest (9)					
			0	0%	2 dorsal faces, 1 crest, one cortex (10)			279	44.4%	2 dorsal faces (4)
			0	0%	2 dorsal faces, 1 sided crest and trim (11)					
	Rönneholm	423	0	0%	dorsal cortex (1)					
			5	1%	2 dorsal faces, 1 cortex (2)			278	44.3%	3 dorsal faces (5)
			2	0%	3 dorsal faces, 1 cortex (3)					
			198	47%	2 dorsal faces (4)					
			183	43%	3 dorsal faces (5)			46	7.3%	multi dorsal faces (6)
			30	7%	multi dorsal faces (6)					
			0	0%	bilaterally crested blade (7)					
			4	1%	2 dorsal faces, 1 crest (8)			0	0.0%	bilaterally crested blade (7)
			1	0%	3 dorsal faces, 1 crest (9)					
			0	0%	2 dorsal faces, 1 crest, one cortex (10)					
			0	0%	2 dorsal faces, 1 sided crest and trim (11)			5	0.8%	2 dorsal faces, 1 crest (8)
	Tågerup	187	1	1%	dorsal cortex (1)					
			8	4%	2 dorsal faces, 1 cortex (2)					
			3	2%	3 dorsal faces, 1 cortex (3)			1	0.2%	3 dorsal faces, 1 crest (9)
			71	38%	2 dorsal faces (4)					
			87	47%	3 dorsal faces (5)					
			16	9%	multi dorsal faces (6)			0	0.0%	2 dorsal faces, 1 crest, one cortex (10)
			0	0%	bilaterally crested blade (7)					
			1	1%	2 dorsal faces, 1 crest (8)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
			0	0%	3 dorsal faces, 1 crest (9)			0	0,0%	2 dorsal faces, 1 sided crest and trim (11)
			0	0%	2 dorsal faces, 1 crest, one cortex (10)					
			0	0%	2 dorsal faces, 1 sided crest and trim (11)					
(BT1) Blade termination 1	Ljungaviken	84	81	96%	not remaining/broken (0)	**(BT1) Blade termination 1**	699	401	57.4%	not remaining/broken (0)
			0	0%	ideal (1)					
			0	0%	feathered (2)					
			0	0%	plunged (3)			178	25.5%	ideal (1)
			3	4%	hinged (4)					
	Rönneholm	427	235	55%	not remaining/broken (0)					
			118	28%	ideal (1)			105	15.0%	feathered (2)
			66	15%	feathered (2)					
			3	1%	plunged (3)					
			5	1%	hinged (4)			3	0.4%	plunged (3)
	Tågerup	188	85	45%	not remaining/broken (0)					
			60	32%	ideal (1)					
			39	21%	feathered (2)			12	1.7%	hinged (4)
			0	0%	plunged (3)					
			4	2%	hinged (4)					
(BT2) Blade termination 2	Ljungaviken	0	0	0%	pointed (1)	**(BT2) Blade termination 2**	276	140	50.7%	pointed (1)
			0	0%	straight (2)					
	Rönneholm	184	104	57%	pointed (1)					
			80	43%	straight (2)			136	49.3%	straight (2)
	Tågerup	92	36	39%	pointed (1)					
			56	61%	straight (2)					
(CURV) Blade curvature	Ljungaviken	95	33	35%	straight (1)	**(CURV) Blade curvature**	653	200	30.6%	straight (1)
			8	8%	distal curvature (2)					
			54	57%	even curvature (3)					
			0	0%	curv + ventral belly (4)			89	13.6%	distal curvature (2)
	Rönneholm	382	106	28%	straight (1)					
			55	14%	distal curvature (2)					
			214	56%	even curvature (3)			356	54.5%	even curvature (3)
			7	2%	curv + ventral belly (4)					
	Tågerup	176	61	35%	straight (1)					
			26	15%	distal curvature (2)			8	1.2%	curv + ventral belly (4)
			88	50%	even curvature (3)					
			1	1%	curv + ventral belly (4)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(TWIST) Twist	Ljungaviken	95	61	64%	no twist (0)	(TWIST) Twist	682	463	67.9%	no twist (0)
			34	36%	twist (1)					
	Rönneholm	403	278	69%	no twist (0)					
			125	31%	twist (1)			219	32.1%	twist (1)
	Tågerup	184	124	67%	no twist (0)					
			60	33%	twist (1)					
(WN) Wallner lines	Ljungaviken	116	46	40%	no Wallner lines (0)	(WN) Wallner lines	737	130	17.6%	no Wallner lines (0)
			48	41%	fine Wallner lines (1)					
			22	19%	broad Wallner lines (2)					
	Rönneholm	430	54	13%	no Wallner lines (0)			548	74.4%	fine Wallner lines (1)
			355	83%	fine Wallner lines (1)					
			21	5%	broad Wallner lines (2)					
	Tågerup	191	30	16%	no Wallner lines (0)			59	8.0%	broad Wallner lines (2)
			145	76%	fine Wallner lines (1)					
			16	8%	broad Wallner lines (2)					
(REG) Blade regularity	Ljungaviken	114	26	23%	irregular (1)	(REG) Blade regularity	728	119	16.3%	irregular (1)
			84	74%	regular (2)					
			4	4%	extremely regular (3)					
	Rönneholm	423	64	15%	irregular (1)			554	76.1%	regular (2)
			341	81%	regular (2)					
			18	4%	extremely regular (3)					
	Tågerup	191	29	15%	irregular (1)			55	7.6%	extremely regular (3)
			129	68%	regular (2)					
			33	17%	extremely regular (3)					
(SFPD) Platform preparation dorsal	Ljungaviken	120	0	0%	no preparation (0)	(SFPD) Platform preparation dorsal	739	42	5.7%	no preparation (0)
			49	41%	abrasion (1)					
			25	21%	trimming (2)					
			46	38%	trimming + abrasion (3)			216	29.2%	abrasion (1)
	Rönneholm	428	28	7%	no preparation (0)					
			149	35%	abrasion (1)					
			108	25%	trimming (2)			221	29.9%	trimming (2)
			143	33%	trimming + abrasion (3)					
	Tågerup	191	14	7%	no preparation (0)					
			18	9%	abrasion (1)			260	35.2%	trimming + abrasion (3)
			88	46%	trimming (2)					
			71	37%	trimming + abrasion (3)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(SFPE) Platform preservation	Ljungaviken	115	0	0%	no preservation (0)	(SFPE) Platform preservation	733	0	0.0%	no preservation (0)
			2	2%	natural surface/cortex (1)					
			101	88%	smooth (2)					
			0	0%	crushed (3)			4	0.5%	natural surface/cortex (1)
			0	0%	polished (4)					
			12	10%	faceted, 2 facets (5)					
			0	0%	faceted, >2 facets (7)			692	94.4%	smooth (2)
	Rönneholm	429	0	0%	no preservation (0)					
			0	0%	natural surface/cortex (1)					
			419	98%	smooth (2)			12	1.6%	crushed (3)
			8	2%	crushed (3)					
			0	0%	polished (4)					
			2	0%	faceted, 2 facets (5)			0	0.0%	polished (4)
			0	0%	faceted, >2 facets (7)					
	Tågerup	189	0	0%	no preservation (0)					
			2	1%	natural surface/cortex (1)			22	3.0%	faceted, 2 facets (5)
			172	91%	smooth (2)					
			4	2%	crushed (3)					
			0	0%	polished (4)			3	0.4%	faceted, >2 facets (7)
			8	4%	faceted, 2 facets (5)					
			3	2%	faceted, >2 facets (7)					
(KE) Conus formation	Ljungaviken	114	89	78%	no conus (0)	(KE) Conus formation	722	599	83.0%	no conus (0)
			20	18%	existing (1)					
			4	4%	visible only on platform (2)					
			1	1%	double (3)			103	14.3%	existing (1)
	Rönneholm	420	362	86%	no conus (0)					
			46	11%	existing (1)					
			12	3%	visible only on platform (2)			19	2.6%	visible only on platform (2)
			0	0%	double (3)					
	Tågerup	188	148	79%	no conus (0)					
			37	20%	existing (1)			1	0.1%	double (3)
			3	2%	visible only on platform (2)					
			0	0%	double (3)					

Local scale						Regional scale				
Attribute	**Site**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**	**Attribute**	**Total no. of finds**	**No. of finds/ Meas. for metric**	**(%)**	**Attribute morphology**
(SL) Lip	Ljungaviken	120	16	13%	no lip (0)	**(SL) Lip**	732	271	37.0%	no lip (0)
			91	76%	diffuse (1)					
			1	1%	pronounced (2)					
			12	10%	only lateral/partial (3)			439	60.0%	diffuse (1)
	Rönneholm	421	171	41%	no lip (0)					
			244	58%	diffuse (1)					
			6	1%	pronounced (2)			10	1.4%	pronounced (2)
			0	0%	only lateral/partial (3)					
	Tågerup	191	84	44%	no lip (0)					
			104	54%	diffuse (1)			12	1.6%	only lateral/partial (3)
			3	2%	pronounced (2)					
			0	0%	only lateral/partial (3)					
(SFRD) Platform width	Ljungaviken	119	4.134 mm		in mm	**(SFRD) Platform width**	725	3.09 mm		platform width
	Rönneholm	421	2.864 mm		in mm					
	Tågerup	185	2.92 mm		in mm					
(SFRK) Platform thickness	Ljungaviken	119	1.545 mm		in mm	**(SFRK) Platform thickness**	725	1.11 mm		platform thickness
	Rönneholm	421	1.114 mm		in mm					
	Tågerup	185	1.058 mm		in mm					
Blade length (L) fullbl	Ljungaviken	38	39.76 mm		in mm	**Blade length (L) fullbl**	331	23.71 mm		length
	Rönneholm	196	19.67 mm		in mm					
	Tågerup	97	25.6 mm		in mm					
Blade width (B) fullbl	Ljungaviken	120	11.25 mm		in mm	**Blade width (B) fullbl**	331	6.89 mm		width
	Rönneholm	431	6.155 mm		in mm					
	Tågerup	191	7.036 mm		in mm					
Blade thickness (D) fullbl	Ljungaviken	120	2.802 mm		in mm	**Blade thickness (D) fullbl**	331	1.65 mm		thickness
	Rönneholm	431	1.341 mm		in mm					
	Tågerup	191	1,732		in mm					

Table 8. Data set for blades – Focus area 2b.

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(DBF) Dorsal blade face	Satrup LA 2 – 2010	174	0	0.0%	dorsal cortex (1)	(DBF) Dorsal blade face	323	0	0.0%	dorsal cortex (1)
			8	4.6%	2 dorsal faces, 1 cortex (2)					
			7	4.0%	3 dorsal faces, 1 cortex (3)			13	4.0%	2 dorsal faces, 1 cortex (2)
			73	42.0%	2 dorsal faces (4)					
			69	39.7%	3 dorsal faces (5)			12	3.7%	3 dorsal faces, 1 cortex (3)
			11	6.3%	multi dorsal faces (6)					
			1	0.6%	bilaterally crested blade (7)			156	48.3%	2 dorsal faces (4)
			4	2.3%	2 dorsal faces, 1 crest (8)					
			1	0.6%	3 dorsal faces, 1 crest (9)			112	34.7%	3 dorsal faces (5)
			0	0.0%	2 dorsal faces, 1 crest, one cortex (10)					
			0	0.0%	2 dorsal faces, 1 sided crest and trim (11)			22	6.8%	multi dorsal faces (6)
	Satrup LA 2 – 2016	149	0	0.0%	dorsal cortex (1)					
			5	3.4%	2 dorsal faces, 1 cortex (2)			1	0.3%	bilaterally crested blade (7)
			5	3.4%	3 dorsal faces, 1 cortex (3)					
			83	55.7%	2 dorsal faces (4)			6	1.9%	2 dorsal faces, 1 crest (8)
			43	28.9%	3 dorsal faces (5)					
			11	7.4%	multi dorsal faces (6)			1	0.3%	3 dorsal faces, 1 crest (9)
			0	0.0%	bilaterally crested blade (7)					
			2	1.3%	2 dorsal faces, 1 crest (8)			0	0.0%	2 dorsal faces, 1 crest, one cortex (10)
			0	0.0%	3 dorsal faces, 1 crest (9)					
			0	0.0%	2 dorsal faces, 1 crest, one cortex (10)			0	0.0%	2 dorsal faces, 1 sided crest and trim (11)
			0	0.0%	2 dorsal faces, 1 sided crest and trim (11)					
(BT1) Blade termination 1	Satrup LA 2 – 2010	174	108	62.1%	not remaining/broken (0)	(BT1) Blade termination 1	331	179	54.1%	not remaining/broken (0)
			37	21.3%	ideal (1)					
			22	12.6%	feathered (2)			91	27.5%	ideal (1)
			3	1.7%	plunged (3)					
			4	2.3%	hinged (4)			50	15.1%	feathered (2)
	Satrup LA 2 – 2016	157	71	45.2%	not remaining/broken (0)					
			54	34.4%	ideal (1)			5	1.5%	plunged (3)
			28	17.8%	feathered (2)					
			2	1.3%	plunged (3)			6	1.8%	hinged (4)
			2	1.3%	hinged (4)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(BT2) Blade termination 2	Satrup LA 2 – 2010	59	23	39.0%	pointed (1)	(BT2) Blade termination 2	134	53	39.6%	pointed (1)
			36	61.0%	straight (2)					
	Satrup LA 2 – 2016	75	30	40.0%	pointed (1)			81	60.4%	straight (2)
			45	60.0%	straight (2)					
(CURV) Blade curvature	Satrup LA 2 – 2010	159	45	28.3%	straight (1)	(CURV) Blade curvature	310	90	29.0%	straight (1)
			8	5.0%	distal curvature (2)					
			106	66.7%	even curvature (3)			16	5.2%	distal curvature (2)
			0	0.0%	curv + ventral belly (4)					
	Satrup LA 2 – 2016	151	45	29.8%	straight (1)			196	63.2%	even curvature (3)
			8	5.3%	distal curvature (2)					
			90	59.6%	even curvature (3)			8	2.6%	curv + ventral belly (4)
			8	5.3%	curv + ventral belly (4)					
(TWIST) Twist	Satrup LA 2 – 2010	167	106	63.5%	no twist (0)	(TWIST) Twist	326	179	54.9%	no twist (0)
			61	36.5%	twist (1)					
	Satrup LA 2 – 2016	159	73	45.9%	no twist (0)			147	45.1%	twist (1)
			86	54.1%	twist (1)					
(WN) Wallner lines	Satrup LA 2 – 2010	180	43	23.9%	no Wallner lines (0)	(WN) Wallner lines	341	69	20.2%	no Wallner lines (0)
			108	60.0%	fine Wallner lines (1)					
			29	16.1%	broad Wallner lines (2)			203	59.5%	fine Wallner lines (1)
	Satrup LA 2 – 2016	161	26	16.1%	no Wallner lines (0)					
			95	59.0%	fine Wallner lines (1)			69	20.2%	broad Wallner lines (2)
			40	24.8%	broad Wallner lines (2)					
(REG) Blade regularity	Satrup LA 2 – 2010	175	31	17.7%	irregular (1)	(REG) Blade regularity	332	52	15.7%	irregular (1)
			129	73.7%	regular (2)					
			15	8.6%	extremely regular (3)			251	75.6%	regular (2)
	Satrup LA 2 – 2016	157	21	13.4%	irregular (1)					
			122	77.7%	regular (2)			29	8.7%	extremely regular (3)
			14	8.9%	extremely regular (3)					
(SFPD) Platform preparation dorsal	Satrup LA 2 – 2010	181	11	6.1%	no preparation (0)	(SFPD) Platform preparation dorsal	305	24	7.9%	no preparation (0)
			25	13.8%	abrasion (1)					
			51	28.2%	trimming (2)			39	12.8%	abrasion (1)
			94	51.9%	trimming + abrasion (3)					
	Satrup LA 2 – 2016	124	13	10.5%	no preparation (0)			100	32.8%	trimming (2)
			14	11.3%	abrasion (1)					
			49	39.5%	trimming (2)			142	46.6%	trimming + abrasion (3)
			48	38.7%	trimming + abrasion (3)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(SFPE) Platform preservation	Satrup LA 2 – 2010	178	4	2.2%	no preservation (0)	(SFPE) Platform preservation	298	6	2.0%	no preservation (0)
			0	0.0%	natural surface/cortex (1)					
			142	79.8%	smooth (2)			1	0.3%	natural surface/cortex (1)
			17	9.6%	crushed (3)					
			0	0.0%	polished (4)			229	76.8%	smooth (2)
			14	7.9%	faceted, 2 facets (5)					
			1	0.6%	faceted, >2 facets (7)			32	10.7%	crushed (3)
	Satrup LA 2 – 2016	120	2	1.7%	no preservation (0)					
			1	0.8%	natural surface/cortex (1)			0	0.0%	polished (4)
			87	72.5%	smooth (2)					
			15	12.5%	crushed (3)			26	8.7%	faceted, 2 facets (5)
			0	0.0%	polished (4)					
			12	10.0%	faceted, 2 facets (5)			4	1.3%	faceted, >2 facets (7)
			3	2.5%	faceted, >2 facets (7)					
(KE) Conus formation	Satrup LA 2 – 2010	156	120	76.9%	no conus (0)	(KE) Conus formation	262	193	73.7%	no conus (0)
			30	19.2%	existing (1)					
			4	2.6%	visible only on platform (2)			60	22.9%	existing (1)
			2	1.3%	double (3)					
	Satrup LA 2 – 2016	106	73	68.9%	no conus (0)			7	2.7%	visible only on platform (2)
			30	28.3%	existing (1)					
			3	2.8%	visible only on platform (2)			2	0.8%	double (3)
			0	0.0%	double (3)					
(SL) Lip	Satrup LA 2 – 2010	159	41	25.8%	no lip (0)	(SL) Lip	274	84	30,7%	no lip (0)
			110	69.2%	diffuse (1)					
			8	5.0%	pronounced (2)			178	65,0%	diffuse (1)
			0	0.0%	only lateral/partial (3)					
	Satrup LA 2 – 2016	115	43	37.4%	no lip (0)			12	4,4%	pronounced (2)
			68	59.1%	diffuse (1)					
			4	3.5%	pronounced (2)			0	0,0%	only lateral/partial (3)
			0	0.0%	only lateral/partial (3)					
(SFRD) Platform width	Satrup LA 2 – 2010	163	4.701 mm		in mm	(SFRD) Platform width	269	4.27 mm		Platform width
	Satrup LA 2 – 2016	106	3.615 mm		in mm					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/ Meas. for metric	(%)	Attribute morphology
(SFRK) Platform thickness	Satrup LA 2 – 2010	162	1.558 mm		in mm	(SFRK) Platform thickness	269	1.46 mm		platform Thickness
	Satrup LA 2 – 2016	106	1.306 mm		in mm					
(L) Blade length – fullbl	Satrup LA 2 – 2010	66	37.61 mm		in mm	(L) Blade length – fullbl	131	34.91 mm		blade length
	Satrup LA 2 – 2016	65	32.17 mm		in mm					
(B) Blade width – fillbl	Satrup LA 2 – 2010	66	13.06 mm		in mm	(B) Blade width – fillbl	131	11.1 mm		blade width
	Satrup LA 2 – 2016	65	9.11 mm		in mm					
(D) Blade thickness – fullbl	Satrup LA 2 – 2010	66	3.53 mm		in mm	(D) Blade thickness – fullbl	131	3.26 mm		blade thickness
	Satrup LA 2 – 2016	65	2.91 mm		in mm					

Table 9. Data set for blades – Focus area 3.

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology
(DBF) Dorsal blade face	Krøgenes D2	40	0	0.0%	dorsal cortex (1)	(DBF) Dorsal blade face	385	1	0.3%	dorsal cortex (1)
			0	0.0%	2 dorsal faces, 1 cortex (2)					
			0	0.0%	3 dorsal faces, 1 cortex (3)					
			16	40.0%	2 dorsal faces (4)					
			23	57.5%	3 dorsal faces (5)			2	0.5%	2 dorsal faces, 1 cortex (2)
			1	2.5%	multi dorsal faces (6)					
			0	0.0%	bilaterally crested blade (7)					
			0	0.0%	2 dorsal faces, 1 crest (8)					
			0	0.0%	3 dorsal faces, 1 crest (9)			2	0.5%	3 dorsal faces, 1 cortex (3)
			0	0.0%	2 dorsal faces, 1 crest, one cortex (10)					
			0	0.0%	2 dorsal faces, 1 sided crest and trim (11)					
	Stene terrasse	17	0	0.0%	dorsal cortex (1)					
			0	0.0%	2 dorsal faces, 1 cortex (2)			136	35.3%	2 dorsal faces (4)
			0	0.0%	3 dorsal faces, 1 cortex (3)					
			10	58.8%	2 dorsal faces (4)					
			7	41.2%	3 dorsal faces (5)					
			0	0.0%	multi dorsal faces (6)			218	56.6%	3 dorsal faces (5)
			0	0.0%	bilaterally crested blade (7)					
			0	0.0%	2 dorsal faces, 1 crest (8)					
			0	0.0%	3 dorsal faces, 1 crest (9)					
			0	0.0%	2 dorsal faces, 1 crest, one cortex (10)			25	6.5%	multi dorsal faces (6)
			0	0.0%	2 dorsal faces, 1 sided crest and trim (11)					
	Stokke/Poland 8	58	0	0.0%	dorsal cortex (1)					
			0	0.0%	2 dorsal faces, 1 cortex (2)					
			1	1.7%	3 dorsal faces, 1 cortex (3)			0	0.0%	bilaterally crested blade (7)
			12	20.7%	2 dorsal faces (4)					
			40	69.0%	3 dorsal faces (5)					
			5	8.6%	multi dorsal faces (6)					
			0	0.0%	bilaterally crested blade (7)			1	0.3%	2 dorsal faces, 1 crest (8)
			0	0.0%	2 dorsal faces, 1 crest (8)					
			0	0.0%	3 dorsal faces, 1 crest (9)					
			0	0.0%	2 dorsal faces, 1 crest, one cortex (10)					
			0	0.0%	2 dorsal faces, 1 sided crest and trim (11)			0	0.0%	3 dorsal faces, 1 crest (9)

Local scale						Regional scale				
Attribute	**Site**	**Total no. of finds**	**No. of finds/Meas. for metric**	**(%)**	**Attribute morpho-logy**	**Attribute**	**Total no. of finds**	**No. of finds/Meas. for metric**	**(%)**	**Attribute morpho-logy**
	Vallermyrene 4	270	1	0.4%	dorsal cortex (1)					
			2	0.7%	2 dorsal faces, 1 cortex (2)					
			1	0.4%	3 dorsal faces, 1 cortex (3)					
			98	36.3%	2 dorsal faces (4)			0	0.0%	2 dorsal faces, 1 crest, one cortex (10)
			148	54.8%	3 dorsal faces (5)					
			19	7.0%	multi dorsal faces (6)					
			0	0.0%	bilaterally crested blade (7)					
			1	0.4%	2 dorsal faces, 1 crest (8)			0	0.0%	2 dorsal faces, 1 sided crest and trim (11)
			0	0.0%	3 dorsal faces, 1 crest (9)					
			0	0.0%	2 dorsal faces, 1 crest, one cortex (10)					
			0	0.0%	2 dorsal faces, 1 sided crest and trim (11)					
(BT1) Blade termination 1	Krøgenes D2	40	28	70.0%	not remaining/broken (0)	**(BT1) Blade termination 1**	385	309	80.3%	not remaining/broken (0)
			12	30.0%	ideal (1)					
			0	0.0%	feathered (2)					
			0	0.0%	plunged (3)					
			0	0.0%	hinged (4)			67	17.4%	ideal (1)
	Stene terrasse	17	15	88.2%	not remaining/broken (0)					
			2	11.8%	ideal (1)					
			0	0.0%	feathered (2)					
			0	0.0%	plunged (3)			7	1.8%	feathered (2)
			0	0.0%	hinged (4)					
	Stokke/Polland 8	58	43	74.1%	not remaining/broken (0)					
			11	19.0%	ideal (1)					
			4	6.9%	feathered (2)			1	0.3%	plunged (3)
			0	0.0%	plunged (3)					
			0	0.0%	hinged (4)					
	Vallermyrene 4	270	223	82.6%	not remaining/broken (0)					
			42	15.6%	ideal (1)			1	0.3%	hinged (4)
			3	1.1%	feathered (2)					
			1	0.4%	plunged (3)					
			1	0.4%	hinged (4)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology
(BT2) Blade termination 2	Krøgenes D2	13	3	23.1%	pointed (1)	(BT2) Blade termination 2	75	41	54.7%	pointed (1)
			10	76.9%	straight (2)					
	Stene terrasse	2	1	50.0%	pointed (1)					
			1	50.0%	straight (2)					
	Stokke/Polland 8	14	7	50.0%	pointed (1)			34	45.3%	straight (2)
			7	50.0%	straight (2)					
	Vallermyrene 4	46	30	65.2%	pointed (1)					
			16	34.8%	straight (2)					
(CURV) Blade curvature	Krøgenes D2	32	13	40.6%	straight (1)	(CURV) Blade curvature	262	108	41.2%	straight (1)
			7	21.9%	distal curvature (2)					
			12	37.5%	even curvature (3)					
			0	0.0%	curv + ventral belly (4)					
	Stene terrasse	10	5	50.0%	straight (1)			45	17.2%	distal curvature (2)
			1	10.0%	distal curvature (2)					
			4	40.0%	even curvature (3)					
			0	0.0%	curv + ventral belly (4)					
	Stokke/Polland 8	43	13	30.2%	straight (1)			108	41.2%	even curvature (3)
			9	20.9%	distal curvature (2)					
			20	46.5%	even curvature (3)					
			1	2.3%	curv + ventral belly (4)					
	Vallermyrene 4	177	77	43.5%	straight (1)			1	0.4%	curv + ventral belly (4)
			28	15.8%	distal curvature (2)					
			72	40.7%	even curvature (3)					
			0	0.0%	curv + ventral belly (4)					
(TWIST) Twist	Krøgenes D2	37	23	62.2%	no twist (0)	(TWIST) Twist	313	184	58.8%	no twist (0)
			14	37.8%	twist (1)					
	Stene terrasse	13	10	76.9%	no twist (0)					
			3	23.1%	twist (1)					
	Stokke/Polland 8	47	26	55.3%	no twist (0)			129	41.2%	twist (1)
			21	44.7%	twist (1)					
	Vallermyrene 4	216	125	57.9%	no twist (0)					
			91	42.1%	twist (1)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology
(WN) Wallner lines	Krøgenes D2	40	14	35.0%	no Wallner lines (0)	(WN) Wallner lines	382	171	44.8%	no Wallner lines (0)
			21	52.5%	fine Wallner lines (1)					
			5	12.5%	broad Wallner lines (2)					
	Stene terrasse	16	15	93.8%	no Wallner lines (0)					
			1	6.3%	fine Wallner lines (1)			166	43.5%	fine Wallner lines (1)
			0	0.0%	broad Wallner lines (2)					
	Stokke/Polland 8	57	23	40.4%	no Wallner lines (0)					
			29	50.9%	fine Wallner lines (1)					
			5	8.8%	broad Wallner lines (2)			45	11.8%	broad Wallner lines (2)
	Vallermyrene 4	269	119	44.2%	no Wallner lines (0)					
			115	42.8%	fine Wallner lines (1)					
			35	13.0%	broad Wallner lines (2)					
(REG) Blade regularity	Krøgenes D2	40	2	5.0%	irregular (1)	(REG) Blade regularity	374	70	18.7%	irregular (1)
			29	72.5%	regular (2)					
			9	22.5%	extremely regular (3)					
	Stene terrasse	16	5	31.3%	irregular (1)					
			10	62.5%	regular (2)			278	74.3%	regular (2)
			1	6.3%	extremely regular (3)					
	Stokke/Polland 8	52	11	21.2%	irregular (1)					
			39	75.0%	regular (2)					
			2	3.8%	extremely regular (3)			26	7.0%	extremely regular (3)
	Vallermyrene 4	266	52	19.5%	irregular (1)					
			200	75.2%	regular (2)					
			14	5.3%	extremely regular (3)					
(SFPD) Platform preparation dorsal	Krøgenes D2	40	1	2.5%	no preparation (0)	(SFPD) Platform preparation dorsal	382	53	13.9%	no preparation (0)
			3	7.5%	abrasion (1)					
			32	80.0%	trimming (2)					
			4	10.0%	trimming + abrasion (3)					
	Stene terrasse	16	2	12.5%	no preparation (0)			29	7.6%	abrasion (1)
			2	12.5%	abrasion (1)					
			10	62.5%	trimming (2)					
			2	12.5%	trimming + abrasion (3)					
	Stokke/Polland 8	58	18	31.0%	no preparation (0)			267	69.9%	trimming (2)
			0	0.0%	abrasion (1)					
			38	65.5%	trimming (2)					
			2	3.4%	trimming + abrasion (3)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology
	Vallermyrene 4	268	32	11.9%	no preparation (0)			33	8.6%	trimming + abrasion (3)
			24	9.0%	abrasion (1)					
			187	69.8%	trimming (2)					
			25	9.3%	trimming + abrasion (3)					
(SFPE) Platform preservation	Krøgenes D2	40	0	0.0%	no preservation (0)	(SFPE) Platform preservation	372	4	1.1%	no preservation (0)
			0	0.0%	natural surface/cortex (1)					
			37	92.5%	smooth (2)					
			0	0.0%	crushed (3)					
			0	0.0%	polished (4)			0	0.0%	natural surface/cortex (1)
			3	7.5%	faceted, 2 facets (5)					
			0	0.0%	faceted, >2 facets (7)					
	Stene terrasse	15	0	0.0%	no preservation (0)					
			0	0.0%	natural surface/cortex (1)			256	68.8%	smooth (2)
			14	93.3%	smooth (2)					
			0	0.0%	crushed (3)					
			0	0.0%	polished (4)					
			1	6.7%	faceted, 2 facets (5)			14	3.8%	crushed (3)
			0	0.0%	faceted, >2 facets (7)					
	Stokke/Polland 8	57	0	0.0%	no preservation (0)					
			0	0.0%	natural surface/cortex (1)					
			30	52.6%	smooth (2)			0	0.0%	polished (4)
			4	7.0%	crushed (3)					
			0	0.0%	polished (4)					
			19	33.3%	faceted, 2 facets (5)					
			4	7.0%	faceted, >2 facets (7)			79	21.2%	faceted, 2 facets (5)
	Vallermyrene 4	260	4	1.5%	no preservation (0)					
			0	0.0%	natural surface/cortex (1)					
			175	67.3%	smooth (2)					
			10	3.8%	crushed (3)			19	5.1%	faceted, >2 facets (7)
			0	0.0%	polished (4)					
			56	21.5%	faceted, 2 facets (5)					
			15	5.8%	faceted, >2 facets (7)					

Local scale						Regional scale				
Attribute	Site	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology	Attribute	Total no. of finds	No. of finds/Meas. for metric	(%)	Attribute morphology
(KE) Conus formation	Krøgenes D2	40	38	95.0%	no conus (0)	(KE) Conus formation	364	330	90.7%	no conus (0)
			2	5.0%	existing (1)					
			0	0.0%	visible only on platform (2)					
			0	0.0%	double (3)					
	Stene terrasse	17	14	82.4%	no conus (0)			34	9.3%	existing (1)
			3	17.6%	existing (1)					
			0	0.0%	visible only on platform (2)					
			0	0.0%	double (3)					
	Stokke/Polland 8	55	51	92.7%	no conus (0)			0	0.0%	visible only on platform (2)
			4	7.3%	existing (1)					
			0	0.0%	visible only on platform (2)					
			0	0.0%	double (3)					
	Vallermyrene 4	252	227	90.1%	no conus (0)			0	0.0%	double (3)
			25	9.9%	existing (1)					
			0	0.0%	visible only on platform (2)					
			0	0.0%	double (3)					
(SL) Lip	Krøgenes D2	40	17	42.5%	no lip (0)	(SL) Lip	371	127	34.2%	no lip (0)
			23	57.5%	diffuse (1)					
			0	0.0%	pronounced (2)					
			0	0.0%	only lateral/partial (3)					
	Stene terrasse	17	9	52.9%	no lip (0)			239	64.4%	diffuse (1)
			8	47.1%	diffuse (1)					
			0	0.0%	pronounced (2)					
			0	0.0%	only lateral/partial (3)					
	Stokke/Polland 8	57	27	47.4%	no lip (0)			5	1.3%	pronounced (2)
			30	52.6%	diffuse (1)					
			0	0.0%	pronounced (2)					
			0	0.0%	only lateral/partial (3)					
	Vallermyrene 4	257	74	28.8%	no lip (0)			0	0.0%	only lateral/partial (3)
			178	69.3%	diffuse (1)					
			5	1.9%	pronounced (2)					
			0	0.0%	only lateral/partial (3)					

Local scale						Regional scale				
Attribute	**Site**	**Total no. of finds**	**No. of finds/Meas. for metric**	**(%)**	**Attribute morphology**	**Attribute**	**Total no. of finds**	**No. of finds/Meas. for metric**	**(%)**	**Attribute morphology**
(SFRD) Platform width	Krøgenes D2	40	2.655 mm		in mm	**(SFRD) Platform width**	371	2.69 mm		platform width
	Stene terrasse	17	2.288 mm		in mm					
	Stokke/Polland 8	56	2.58 mm		in mm					
	Vallermyrene 4	258	2.739 mm		in mm					
(SFRK) Platform thickness	Krøgenes D2	40	1.038 mm		in mm	**(SFRK) Platform thickness**	371	1.05 mm		platform thickness
	Stene terrasse	17	1.065 mm		in mm					
	Stokke/Polland 8	56	1.086 mm		in mm					
	Vallermyrene 4	258	1.045 mm		in mm					
Blade length (L) fullbl	Krøgenes D2	13	19.32 mm		in mm	**Blade length (L) fullbl**	75	19.83 mm		blade length
	Stene terrasse	2	21.9 mm		in mm					
	Stokke/Polland 8	14	20.31 mm		in mm					
	Vallermyrene 4	46	19.74 mm		in mm					
Blade width (B)	Krøgenes D2	13	5.27 mm		in mm	**Blade width (B)**	75	5.97 mm		blade width
	Stene terrasse	2	6.65 mm		in mm					
	Stokke/Polland 8	14	5.67 mm		in mm					
	Vallermyrene 4	46	6.23 mm		in mm					
Blade thickness (D)	Krøgenes D2	13	1.33 mm		in mm	**Blade thickness (D)**	75	1.56 mm		blade thickness
	Stene terrasse	2	1.95 mm		in mm					
	Stokke/Polland 8	14	1.67 mm		in mm					
	Vallermyrene 4	46	1.57 mm		in mm					

Appendix II – Radiocarbon dates

Table 10. Radiocarbon data.

Site	Country, area	Source	Sample name	BP	BP error	Cal BC (2σ) start
Ageröd I:B	Sweden, Scania	Larsson, L. 1978	Lu-598A	6040	70	5208
Ageröd I:B	Sweden, Scania	Larsson, L. 1978	Lu-598	6290	70	5470
Ageröd I:B	Sweden, Scania	Larsson, L. 1978	Lu-600	6380	70	5477
Ageröd I:B	Sweden, Scania	Larsson, L. 1978	Lu-698	7960	80	7058
Ageröd I:B	Sweden, Scania	Larsson, L. 1978	Lu-873	8000	80	7133
Ageröd I:B	Sweden, Scania	Larsson, L. 1978	Lu-599	8020	80	7175
Ageröd I:D	Sweden, Scania	Larsson, L. 1978	Lu-760	7680	80	6683
Ageröd I:D	Sweden, Scania	Larsson, L. 1978	Lu-991	7780	80	7023
Ageröd I:D	Sweden, Scania	Larsson, L. 1978	Lu-751	7940	80	7054
Ageröd V	Sweden, Scania	Larsson, L. 1983	Lu-697	6540	75	5626
Ageröd V	Sweden, Scania	Larsson, L. 1983	Lu-1622	6680	70	5713
Ageröd V	Sweden, Scania	Larsson, L. 1983	Lu-1502	6710	70	5729
Ageröd V	Sweden, Scania	Larsson, L. 1983	Lu-696	6720	75	5737
Ageröd V	Sweden, Scania	Larsson, L. 1983	Lu-963	6800	90	5890
Ageröd V	Sweden, Scania	Larsson, L. 1983	Lu-1623	6860	70	5895
Arlöv I	Sweden, Scania	Asplund, A. and Eklund, M. 1984	Lu-756	6160	75	5305
Arlöv I	Sweden, Scania	Asplund, A. and Eklund, M. 1984	Lu-757	6290	70	5470
Arlöv I	Sweden, Scania	Asplund, A. and Eklund, M. 1984	Lu-1007	6640	100	5729
Årup	Sweden, Scania	Hanlon, J. 2003	Ua-26447	7055	165	6240
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN-14134	7960	30	7040
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	AAR-14549	7989	36	7050
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN-14133	7990	30	7049
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN-14087	7990	40	7051
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN-14085	8120	50	7325
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14086	8350	40	7530
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	AAR-14834	8405	40	7579
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	KIA-42075	8445	50	7589
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	POZ-46389	8480	40	7589
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN-14137	8490	40	7591
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14089	8670	40	7778
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14207	8840	70	8237
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14090	8970	60	8289
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14136	9010	40	8296
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14208	10200	100	10511
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14088	9800	40	9317
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14210	9830	70	9655
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	KIA-42076	9835	50	9444
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14135	9850	40	9442

Cal BC (2σ) end	Sample material	Context of date	Ass. Find
4731	humus	Refuse layer	HC and blades at the site
5048	drift peat	Upper part of refuse layer	HC and blades at the site
5216	drift peat	Mid-part of refuse layer	HC and blades at the site
6650	charcoal	Refuse layer 2	HC and blades at the site
6652	charcoal	Refuse layer 2	HC and blades at the site
6654	charcoal	Refuse layer 2	HC and blades at the site
6398	bone (*Sus scrofa*, mandibula)	UNKNOWN	HC and blades at the site
6444	charcoal (*Alnus* and *Corylus*)	UNKNOWN	HC and blades at the site
6644	charcoal (*Pinus*)	UNKNOWN	HC and blades at the site
5361	charcoal	Find layer (occupation layer)	HC in the same cultural layer
5482	hazelnut shell	Find layer (mid part of refuse layer)	HC in the same cultural layer
5483	bone (*Cervus elaphus*)	Find layer (upper part of refuse layer)	HC in the same cultural layer
5482	hazelnut shell	Find layer (lower part of occupation layer)	HC in the same cultural layer
5538	charcoal	Find layer (occupation layer)	HC in the same cultural layer
5627	bone (*Alces alces*)	Find layer (lower part of refuse layer)	HC in the same cultural layer
4856	charcoal	Layer K, X52/Y30	HC and blades on the site
5048	charcoal	Layer KS, X54/Y30	HC and blades on the site
5381	charcoal	Layer KS, X53/Y30	HC and blades on the site
5630	charcoal	Top part of peat layer, eastern part of the site	HC and blades found in another part of the site.
6699	wood (plank (no 3) from trackway)	Cultural layer III, sq m 32, depth. -3.22/-3.32 m	microblade production from cores described as handle core/single-fronted concept
6702	bone (*Alces alces*, scapula, knife)	Cultural layer III, sq m 70, depth -2.94/ -3.00 m	microblade production from cores described as handle core/single-fronted concept
6706	wood (plank (no 5) from trackway)	Cultural layer III, sq m 58, depth -3.21/ -3.25 m	microblade production from cores described as handle core/single-fronted concept
6701	wood (plank fragment from trackway)	Cultural layer III, sq m. 40, depth -3.25/ -3.30 m.	microblade production from cores described as handle core/single-fronted concept
6862	wood (thin tree trunk, charred)	Cultural layer III, sq m 5, depth -3.03/ -3.09 m	microblade production from cores described as handle core/single-fronted concept
7201	wood (*Pinus*, stake, burnt)	Cultural layer III, sq m 3-4, depth -3.09/ -3.13 m	microblade production from cores described as handle core/single-fronted concept
7356	bark (binding of a net sinker)	Cultural layer IV, sq m 85. 35.20. depth -380 cm	illustrated single-fronted cores from the same layer
7369	bark (*Salix*, binding of a net sinker)	Cultural layer IV, sq m 46, depth -3.64/ -3.73 m	illustrated single-fronted cores from the same layer
7493	dog coprolite	Cultural layer IV, sq m. 46, depth -365	illustrated single-fronted cores from the same layer
7498	wood (stake)	Cultural layer IV, sq m 24, depth -3.40/ -3.46 m	illustrated single-fronted cores from the same layer
7589	wood (worked plank)	Cultural layer IV, sq m 7, depth -3.68 m,	illustrated single-fronted cores from the same layer
7684	antler (*Alces alces*)	Cultural layer IV, sq m 48-49, depth -3.73/ -3.77 m	illustrated single-fronted cores from the same layer
7957	wood (*Larix*, worked branch)	Cultural layer IV, sq m 6, depth -3.58/ -362 m,	illustrated single-fronted cores from the same layer
8014	wood (*Larix*, stake)	Cultural layer IV, sq m 43, depth -3.78 m,	illustrated single-fronted cores from the same layer
9452	bone (*Alces alces*, scapula)	Cultural layer IV, sq m 41, 86.32, depth -3.70 m	illustrated single-fronted cores from the same layer
9227	wood (*Larix*, stake)	Cultural layer V, sq m 7, sect. 1, depth -3.71/-3.79 m, (horizontally on lake bo om)	microblade production from cores described as handle core/single-fronted concept
9152	bone (*Alces alces*, 2 frag.)	Cultural layer V, sq m 48, depth -3.85/-3.96 m	microblade production from cores described as handle core/single-fronted concept
9231	bone (*Alces alces*, scapula, knife)	Cultural layer V, Sq m 21, depth. -4.04 m,	microblade production from cores described as handle core/single-fronted concept
9247	wood (*Pinus*, planed and charred log)	Cultural layer V, Sq m 42-43, -3.78/ -3.76 m	microblade production from cores described as handle core/single-fronted concept

Site	Country, area	Source	Sample name	BP	BP error	Cal BC (2σ) start
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14209	10060	80	9926
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	KIA-42077	9215	40	8550
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14251	8980	90	8385
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14249	9230	50	8606
Beregovaya 2	Russia, Urals region	Zhilin, M. *et al.* 2014	GIN -14250	9230	60	8616
Berget 1	Norway, Viken	Glørstad, H. 2004; Jaksland, L. 2001	Tua-3276	5965	75	5197
Berget 1	Norway, Viken	Glørstad, H. 2004; Jaksland, L. 2001	Tua-3275	5660	70	4678
Berget 1	Norway, Viken	Glørstad, H. 2004; Jaksland, L. 2001	Tua-3225	5190	75	4238
Blak 1	Denmark, Zealand	Sørensen, S.A. 1996	K-5546	7260	115	6395
Blak 1	Denmark, Zealand	Sørensen, S.A. 1996	K-5664	6960	110	6026
Bökeberg III	Sweden, Scania	Ericsson, C. and Lindblad, J. 1995	Ua-3550	5845	65	4881
Bökeberg III	Sweden, Scania	Ericsson, C. and Lindblad, J. 1995	Ua-3549	6015	75	5206
Bökeberg III	Sweden, Scania	Ericsson, C. and Lindblad, J. 1995	Ua-3551	6375	70	5476
Dammen	Sweden, Bohuslän	Kindgren, H. and Schaller Åhrberg, E. 1999	Ua-5439	7645	80	6649
Dammen	Sweden, Bohuslän	Kindgren, H. and Schaller Åhrberg, E. 1999	T-9133	7860	85	7039
Dammen	Sweden, Bohuslän	Kindgren, H. and Schaller Åhrberg, E. 1999	Ua-5438	8065	85	7316
Dammen	Sweden, Bohuslän	Kindgren, H. and Schaller Åhrberg, E. 1999	Ua-5440	8600	80	7940
Garaselet	Sweden, Västerbotten	Knutsson, K. 1993	Ua-2060	5920	80	5001
Garaselet	Sweden, Västerbotten	Knutsson, K. 1993	Ua-2066	5970	110	5209
Garaselet	Sweden, Västerbotten	Knutsson, K. 1993	Ua-2061	6190	90	5331
Garaselet	Sweden, Västerbotten	Knutsson, K. 1993	Ua-2067	6210	120	5470
Gøngehusvej 7	Denmark, Zealand	Brinch Petersen, P. 2015	K-5992	5829	105	4945
Gøngehusvej 7	Denmark, Zealand	Brinch Petersen, P. 2015	AAR-4457	6150	70	5300
Gøngehusvej 7	Denmark, Zealand	Brinch Petersen, P. 2015	K-6857	6530	60	5618
Gøngehusvej 7	Denmark, Zealand	Brinch Petersen, P. 2015	K-6856	6720	65	5731
Gøngehusvej 7	Denmark, Zealand	Brinch Petersen, P. 2015	K-5105	6850	80	5968
Grądy-Woniecko	Poland, Podlaskie Voivodeship	Wawrusiewicz, A. *et al.* 2017	Poz-85873	5325	35	4316
Grądy-Woniecko	Poland, Podlaskie Voivodeship	Wawrusiewicz, A. *et al.* 2017	Poz-85877	5100	35	3975
Grądy-Woniecko	Poland, Podlaskie Voivodeship	Wawrusiewicz, A. *et al.* 2017	Poz-85874	5035	35	3951
Grądy-Woniecko	Poland, Podlaskie Voivodeship	Wawrusiewicz, A. *et al.* 2017	Poz-85876	4560	50	3496
Halden lok 3	Norway, Viken	Melvold, S. 2006	T-8808	6845	95	5976

Cal BC (2σ) end	Sample material	Context of date	Ass. Find
9323	bone (*Alces alces*, scapula, knife preform)	Cultural layer V, sq m 60-72, depth -3.86/ -3.92 m	microblade production from cores described as handle core/single-fronted concept
8301	bone (tubular bone, tool preform)	Cultural layer V, sq m 20, depth -4.08 m, on lake bottom	microblade production from cores described as handle core/single-fronted concept
7796	wood (*Larix*, stake (no 1))	Cultural layer V, stake point driven into lake bottom: sq m 76, depth -4.12/ -4.61 m	microblade production from cores described as handle core/single-fronted concept
8300	wood (*Larix*, stake (no 2))	Cultural layer V, stake point driven into lake bottom: sq m 76, depth -3.97/ -4.34 m	microblade production from cores described as handle core/single-fronted concept
8297	wood (*Larix*, stake (no 3))	Cultural layer V, stake point driven into lake bottom: sq m 76, depth -3.95/ -4.30 m	microblade production from cores described as handle core/single-fronted concept
4683	charcoal (*Betula*)	Central hearth	several HC, microblades within a hut-structure
4354	charcoal (*Betula*)	Central hearth	several HC, microblades within a hut-structure
3798	charcoal (*Betula*)	From the floor level in the hut structure	several HC, microblades within a hut-structure
5913	wood (*Quercus*)	UNKNOWN	23 HC on site
5641	wood (*Quercus*)	UNKNOWN	23 HC on site
4541	charcoal (*Quercus*)	Construction A9/sample 3 on fig. 3 (Regnell *et al.* 1995)	HC and blades on the site
4718	charcoal	Construction A9/sample 2 on fig. 3 (Regnell *et al.* 1995)	HC and blades on the site
5216	charcoal	Construction A100/Feature 1	HC found adjacent to feature
6273	bone	Cultural layer 1	one HC and ca. 160 microblade fragments found in the same layer
6511	hazelnut shell	Cultural layer 1	one HC and ca. 160 microblade fragments found in the same layer
6695	bone	Cultural layer 1	one HC and ca. 160 microblade fragments found in the same layer
7506	oyster shell	Cultural layer 1	one HC and ca. 160 microblade fragments found in the same layer
4555	charcoal from sediment samples (indet.)	Feature 6	HC in the same area/strat layer as the context (within a few meters)
4603	charcoal from sediment samples (indet.)	Feature 34	HC in the same area/strat layer as the context (within a few meters)
4853	charcoal from sediment samples (indet.)	Feature 8	HC in the same area/strat layer as the context (within a few meters)
4845	charcoal from sediment samples (indet.)	Feature 35	HC in the same area/strat layer as the context (within a few meters)
4450	charcoal	UNKNOWN	HC and slotted bone points in lowermost intact layer of site
4856	charcoal	UNKNOWN	HC and slotted bone points in lowermost intact layer of site
5372	charcoal	N (contextual information is lacking and its relation to the sample is unknown)	HC and slotted bone points in lowermost intact layer
5485	charcoal	Pit Q (contextual information is lacking and its relation to the sample is unknown)	HC and slotted bone points in lowermost intact layer
5622	charcoal	Pit D (contextual information is lacking and its relation to the sample is unknown)	HC and slotted bone points in lowermost intact layer
4048	bone (*Homo sapiens*)	Pit 1, ar 266	HC found in a deposite on the site, not in this context
3797	bone (*Homo sapiens*, burnt)	Layer, ar 470, depth 0.5-0.6 m, bone deposit??	HC found in a deposite on the site, not in this context
3711	food crust on pottery	Surface finds/lacking context	HC found in a deposite on the site
3095	food crust on pottery	Surface finds/lacking context	HC found in a deposite on the site
5566	charcoal	Hearth, feature 25 (S.25). X97/y160, SO, layer 6	HC located within 3 meters

Site	Country, area	Source	Sample name	BP	BP error	Cal BC (2σ) start
Halden lok 3	Norway, Viken	Melvold, S. 2006	T-8807	7490	95	6500
Halden lok 3	Norway, Viken	Melvold, S. 2006	T-8804	7480	115	6568
Halden lok 3	Norway, Viken	Melvold, S. 2006	T-8809	7505	165	6686
Halden lok 3	Norway, Viken	Melvold, S. 2006	TO-1857	7840	70	7032
Ivanovskoye 7	Russia, Upper Volga Region	Zhilin, M. 2009	GIN-9520	9650	110	9301
Ivanovskoye 7	Russia, Upper Volga Region	Zhilin, M. 2009	GIN-9516	9640	70	9251
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-26405	6989	34	5981
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-31536	7030	39	6007
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-31532	7063	42	6022
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-23941	7108	37	6064
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-26398	7140	30	6067
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-31534	7172	34	6080
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-26397	7179	35	6085
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-26404	7210	32	6217
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-31533	7212	34	6217
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-23940	7239	37	6221
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-26403	7238	35	6221
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-26409	7309	41	6236
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-31535	7369	37	6371
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-23701	7387	42	6386
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-26396	7446	32	6396
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-23699	7416	43	6411
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-23700	7469	39	6418
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-26393	7505	50	6443
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-26394	7738	41	6642
Jäckelberg-Huk	Germany, M-V	Lübke, H. *et al.* 2011	KIA-26406	7806	33	6696
Krøgenes D2	Norway, Agder	Mansrud, A. *et al.* 2018	Ua-50982	6132	45	5211
Krøgenes D2	Norway, Agder	Mansrud, A. *et al.* 2018	Beta-448128	6260	30	5314
Krøgenes D2	Norway, Agder	Mansrud, A. *et al.* 2018	Ua-50980	6297	44	5373
Kvestad lok 3	Norway, Viken	Berg, E. 1997	Tua-1547	7435	70	6435
Langangen Vestgård 3	Norway, Vestfold og Telemark	Eggen, I. M. 2014	Tra-2248	5910	10	4834
Langangen Vestgård 3	Norway, Vestfold og Telemark	Eggen, I. M. 2014	Tra-2246	5400	55	4349

Cal BC (2σ) end	Sample material	Context of date	Ass. Find
6087	charcoal	Hearth, feature 24 (S.24). X97/y159, NV, layer 8	HC located within 3 meters
6075	charcoal	Hearth, feature 28 (S.28). X98/y161, SO, layer 6	HC found adjacent to feature
6021	charcoal	Possible hearth, feature 30 (S.30). X100/y166, NO, layer 7	HC found adjacent to feature
6502	charcoal	Hearth, feature 9 (S.9). X99/y161, SO, layer 6	HC found adjacent to feature
8734	bone (*Alces alces*, worked)	Lowest cultura layer, IV	single-fronted cores (not wedge-shaped) in the same layer
8810	wood (beaver gnawed)	Lowest cultura layer, IV	single-fronted cores (not wedge-shaped) in the same layer
5769	hazelnut shell	Trench 5, N100/E114/A1	one HC found on the site, near the big trench (surface find)
5803	bone (*Capreolus capreolus*)	Trench 8, N100/E133/A7	one HC found on the site, near the big trench (surface find)
5842	bone (Mammalia, indet.)	Trench 7, N100/E126/A5	one HC found on the site, near the big trench (surface find)
5900	bone (*Esox*)	Trench 3, N100/E115/-	one HC found on the site, near the big trench (surface find)
5926	bone (Pinnipedia)	Trench 5, N100/E114/A1	one HC found on the site, near the big trench (surface find)
5984	bone (Mammalia, indet.)	Trench 7, N100/E126/A12	one HC found on the site, near the big trench (surface find)
5931	bone (*Cervus elaphus*)	Trench 5, N100/E114/A1	one HC found on the site, near the big trench (surface find)
5993	hazelnut shell	Trench 4, N100/E107/A4	one HC found on the site, near the big trench (surface find)
5994	bone (Pinnipedia)	Trench 7, N100/E126/A7	one HC found on the site, near the big trench (surface find)
6022	bone (Mammalia, indet.)	Trench 2, N100/E109/-	one HC found on the site, near the big trench (surface find)
6022	hazelnut shell	Trench 4, N100/E107/A2	one HC found on the site, near the big trench (surface find)
6071	charcoal	Trench 5, N100/E114/A7	one HC found on the site, near the big trench (surface find)
6084	bone (Mammalia, indet.)	Trench 8, N100/E133/A1	one HC found on the site, near the big trench (surface find)
6088	bone (*Esox*)	Trench 1, N100/E103/-	one HC found on the site, near the big trench (surface find)
6236	bone (*Sus scrofa*)	Trench 5, N100/E112/A6	one HC found on the site, near the big trench (surface find)
6099	bone (*Cervus elaphus*)	Trench 1, N100/E103/-	one HC found on the site, near the big trench (surface find)
6242	bone (Roe deer)	Trench 1, N100/E103/-	one HC found on the site, near the big trench (surface find)
6243	bone (*Esox*)	Trench 5, N100/E114/A5	one HC found on the site, near the big trench (surface find)
6476	bone (Mammalia, indet.)	Trench 5, N100/E114/A5	one HC found on the site, near the big trench (surface find)
6509	hazelnut shell	Trench 5, N100/E114/A5	one HC found on the site, near the big trench (surface find)
4947	charcoal (*Pinus*)	Cultural layer, sample no. P4	HC on site
5076	charcoal (*Pinus*)	Cultural layer (K2), sample no. P3102	HC on site
5082	charcoal (*Pinus*)	Cultural layer, sample no. P1	HC on site
6089	hazelnut shell (burnt)	x54/y55 lag 3. Date relates to area with conical cores.	10 HC and lots of microblades on the site, in a separate area
4721	charcoal (*Pinus*)	Feature 3, cooking pit	mult. HC on site, not dir. rel. to features
4054	charcoal (*Pinus*)	Feature 2, cooking pit	mult. HC on site, not dir. rel. to features

Site	Country, area	Source	Sample name	BP	BP error	Cal BC (2σ) start
Langangen Vestgård 3	Norway, Vestfold og Telemark	Eggen, I. M. 2014	Tra-2247	5325	40	4321
Langangen Vestgård 3	Norway, Vestfold og Telemark	Eggen, I. M. 2014	Tra-2250	5325	40	4321
Langangen Vestgård 3	Norway, Vestfold og Telemark	Eggen, I. M. 2014	Tra-2249	5325	45	4323
Limsjön	Sweden, Dalarna	Larsson, M. 1994	Beta-31136	5000	100	4037
Limsjön	Sweden, Dalarna	Larsson, M. 1994	U-4536	7640	85	6650
Ljungaviken	Sweden, Blekinge	new date	Poz-113765	6860	50	5876
Ljungaviken	Sweden, Blekinge	Kjällqvist, M. and Friman, B. 2017	LuS-12277	6865	55	5883
Ljungaviken	Sweden, Blekinge	Kjällqvist, M. and Friman, B. 2017	Ica-17C/0361	6970	40	5977
Ljungaviken	Sweden, Blekinge	new date	Poz-113764	7050	60	6058
Ljungaviken	Sweden, Blekinge	Kjällqvist, M. and Friman, B. 2017	LuS-12275	7240	50	6225
Ljungaviken	Sweden, Blekinge	Kjällqvist, M. and Friman, B. 2017	LuS-12278	7420	50	6421
Lysinge 1	Sweden, Närke	Artursson, M. Unpublished report	Ua-10895	6220	60	5311
Lysinge 1	Sweden, Närke	Artursson, M. Unpublished report	Ua-10893	6230	65	5321
Lysinge 1	Sweden, Närke	Artursson, M. Unpublished report	Ua-10894	6290	60	5464
Lysinge 1	Sweden, Närke	Artursson, M. Unpublished report	Ua-10896	6335	60	5475
Mogetorp	Sweden, Närke	Ahlbeck, M. *et al.* 2019	Ua-58079	5876	34	4839
Mogetorp	Sweden, Närke	Ahlbeck, M. *et al.* 2019	Ua-58081	5920	35	4898
Nyluspen 1:10, RAÄ 553	Sweden, Lappland	Spång, L.G. 1983; Olofsson, A. 2003	Lu-1572	5570	65	4544
Okayomovo 4	Russia, Upper Volga Region	Zhilin, M.G. 1995	GIN-6204	7490	50	6434
Ore 527	Sweden, Dalarna	Knutsson, K. 2015	Ua-50559	6061	46	5206
Ozerki 5	Russia, Upper Volga Region	Zhilin, M.G. 1996	GIN-6659	7410	90	6426
Ozerki 5	Russia, Upper Volga Region	Zhilin, M.G. 1996	GIN-7217	7120	50	6071
Ozerki 5	Russia, Upper Volga Region	Zhilin, M.G. 1996	GIN-7218	7310	120	6422
Ozerki 5	Russia, Upper Volga Region	Zhilin, M.G. 1996	GIN-6660	7190	180	6409
Ozerki 5	Russia, Upper Volga Region	Zhilin, M.G. 1996	GIN-6662	6970	120	6061
Ozerki 5	Russia, Upper Volga Region	Zhilin, M.G. 1996	GIN-7216	6930	70	5982
Podol 3	Russia, Upper Volga Region	Zhilin, M. and Koltsov, L.V. 2008	LE-5029	9180	75	8612
Podol 3	Russia, Upper Volga Region	Zhilin, M. and Koltsov, L.V. 2008	LE-3772	8630	294	8549
Ramsele raä 128 (Lafssjön)	Sweden, Ångermanland	Jennbert, K. 1985; Olofsson, A. 2003	St-7832	7080	190	6370
Rönneholm 6	Sweden, Scania	Sjöström, A. 2004	LuA-4915	6630	105	5727
Rönneholm 6	Sweden, Scania	Sjöström, A. 2004	LuA-4914	6865	85	5971
Rönneholm 6	Sweden, Scania	Sjöström, A. 2004	LuA-4921	6930	95	5990
Rönneholm 7	Sweden, Scania	Sjöström, A. 2004	Beta 88341	6990	70	5994
Rönneholm 7	Sweden, Scania	Sjöström, A. 2004	LuA-4924	6950	100	6015
Rönneholm 7	Sweden, Scania	Sjöström, A. 2004	LuA-4920	7215	100	6361
Rönneholm 8	Sweden, Scania	Sjöström, A. 2004	LuA-4916	6690	100	5791
Rönneholm 8	Sweden, Scania	Sjöström, A. 2004	LuA-4600	6810	105	5971
Rönneholm 8	Sweden, Scania	Sjöström, A. 2004	Beta-88343	6940	60	5980
Rönneholm 8	Sweden, Scania	Sjöström, A. 2004	LuA-4917	7075	100	6213

Cal BC (2σ) end	Sample material	Context of date	Ass. Find
4046	charcoal (*Pinus*)	Feature 2, cooking pit	mult. HC on site, not dir. rel. to features
4046	charcoal (*Betula*)	Feature 4, cooking pit	mult. HC on site, not dir. rel. to features
3999	charcoal (*Betula*)	Feature 4, cooking pit	mult. HC on site, not dir. rel. to features
3541	charcoal?	Posthole 15	HC on site
6265	charcoal?	Hearth 17	HC on site
5640	charcoal (*Prunus* sp.)	Hearth in Hut 3	HC and blades in hut
5639	charcoal (*Pinus*)	Hearth in Hut 3	HC and blades in hut
5743	charcoal (*Salix* sp.)	Hearth outside of Hut 3	HC and blades in hut. The hearth is located ca. 10 meters away but has been interpreted as synchronous.
5786	charcoal (*Corylus*)	Hearth in Hut 3	HC and blades in hut
6018	charcoal (*Pinus*)	Hearth outside of Hut 3	HC and blades in hut. The hearth is located ca. 10 meters away but has been interpreted as synchronous.
6092	rhizom	Hearth in Hut 3	HC and blades in hut
5011	charcoal	A235 - unknown type	HC on site
5003	charcoal	A202 - unknown type	HC on site
5061	charcoal	A233 - unknown type	HC on site
5136	charcoal	A235 - unknown type	HC on site
4623	charcoal (*Pinus*)	hearth/hearth pit	HC and blades on site
4712	charcoal (*Corylus*)	Possible pit (in context evaluation interpreted as not a feature)	HC and blades on site
4268	charcoal	A possible cooking pit with bone and burnt stones	2 HC in adjacent squares, but on a different strategraphic level
6241	wood (planed plank)	Lower part of layer 9	single-fronted cores in the same layer
4801	bone (burnt)	Taken from test pit 5, Area B, trench 4, X200/Y180	HC found less than 1 meter away, microblades found 2 meters away from sample
6081	charcoal	Upper layer of the fourth (lowest) cultural layer	single-fronted cores on site, irregular blade negatives, lower layer
5894	wood (worked log)	Middle part of the cultural layer	single-fronted cores on site, irregular blade negatives, lower layer
5985	wood (worked)	Upper part of the cultural layer	single-fronted cores on site, irregular blade negatives, lower layer
5736	charcoal	Bottom part of cultural layer, same areas as GIN-6659	single-fronted cores on site, irregular blade negatives, lower layer
5656	wood (*Pinus*)	Bottom of the cultural layer	single-fronted cores on site, irregular blade negatives, lower layer
5671	wood (*Pinus*)	Bottom of the cultural layer	single-fronted cores on site, irregular blade negatives, lower layer
8274	charcoal	Hearth	single-fronted cores from the site
7044	charcoal	Pit filling	single-fronted cores from the site
5630	charcoal	Hearth pit - Feature 2 (Anl 2), in layer 3 (squares x221-222 y94; x221-222 y 95)	3 HC found in adjacent squares of the pit (220/94; 222/95; 220/96) BUT in find layer (1) above the feature. The samples comes from layer 3
5376	wood (*Corylus*, stake)	Part of hut structure	HC and blades in hut
5626	wood (*Corylus*, stake)	Part of hut structure	HC and blades in hut
5643	hazelnut shell	Heart in hut	HC and blades in hut
5731	wood (*Corylus*, stake)	Fnr 30974	HC and blades on the site
5662	hazelnut shell (burnt)	In square X702/Y556	HC and blades on the site
5851	hazelnut shell (burnt)	In Anl. 5	HC and blades on the site
5416	hazelnut shell (burnt)	From hearth A14	HC and blades on the site
5532	charcoal (Nymphaeaceae, seed)	In hearth	HC and blades on the site
5719	charcoal	In square X712.06/Y587.19	HC and blades on the site
5730	wood (stake)	Fnr 11679	HC and blades on the site

Site	Country, area	Source	Sample name	BP	BP error	Cal BC (2σ) start
Rüde LA 2	Germany, S-H	Feulner, F. 2010	Y-441A	5690	70	4698
Rüde LA 2	Germany, S-H	Feulner, F. 2010	Y-160	5750	100	4831
Rüde LA 2	Germany, S-H	Feulner, F. 2010	Y-162	5750	100	4831
Rüde LA 2	Germany, S-H	Feulner, F. 2010	Y-471	5620	200	4938
Rüde LA 2	Germany, S-H	Feulner, F. 2010	H-186/201	5940	100	5202
Rüde LA 2	Germany, S-H	Feulner, F. 2010	H-185/76	6090	145	5363
Sahtysh 14	Russia, Upper Volga Region	Zhilin, M. And Matiskainen, H. 2003	GIN-11053	9010	60	8305
Sahtysh 14	Russia, Upper Volga Region	Zhilin, M. And Matiskainen, H. 2003	GIN-11180	8800	100	8210
Sahtysh 14	Russia, Upper Volga Region	Zhilin, M. And Matiskainen, H. 2003	GIN-11616	9550	60	9208
Sahtysh 14	Russia, Upper Volga Region	Zhilin, M. And Matiskainen, H. 2003	GIN-11624	9450	60	9120
Sahtysh 14	Russia, Upper Volga Region	Zhilin, M. And Matiskainen, H. 2003	GIN-11621	9420	40	8806
Sahtysh 14	Russia, Upper Volga Region	Zhilin, M. And Matiskainen, H. 2003	GIN-11619	9320	40	8709
Sahtysh 14	Russia, Upper Volga Region	Zhilin, M. And Matiskainen, H. 2003	GIN-11615	9450	60	9120
Sahtysh 14	Russia, Upper Volga Region	Zhilin, M. And Matiskainen, H. 2003	GIN-11179	9350	40	8742
Sahtysh 14	Russia, Upper Volga Region	Zhilin, M. And Matiskainen, H. 2003	GIN-11181	9200	90	8632
Satrup LA 2 (Bondebruck)	Germany, S-H	Feulner, F. 2010	KIA-40079	7065	131	6222
Satrup LA 2 (Bondebruck)	Germany, S-H	Feulner, F. 2010	KIA-40080	7001	359	6646
Segebro	Sweden, Scania	Larsson, L. 1982	Lu-758	6970	90	6019
Segebro	Sweden, Scania	Larsson, L. 1982	Lu-855:1	7030	80	6057
Segebro	Sweden, Scania	Larsson, L. 1982	Lu-854	7080	80	6077
Segebro	Sweden, Scania	Larsson, L. 1982	Lu-1501	7140	75	6220
Segebro	Sweden, Scania	Larsson, L. 1982	Lu-855:2	7140	80	6221
Segebro	Sweden, Scania	Larsson, L. 1982	Lu-626	7390	80	6410
Segebro	Sweden, Scania	Larsson, L. 1982	Lu-759	7320	130	6434
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KIA-273	7380	120	6446
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KI-3930	7360	65	6379
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KI-3999.01	7300	55	6333
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KIA-267	7190	70	6226
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KIA-266	7220	40	6221
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	OxA-4479	7150	75	6221
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KIA-264	7020	120	6208
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KIA-263	7130	50	6076
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KIA-274	7070	60	6065
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	OxA-4480	6925	70	5981
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KIA-265	6960	40	5973

Cal BC (2σ) end	Sample material	Context of date	Ass. Find
4364	charcoal?	EBK-cultural layer (sch.82)	HC on site
4362	wood (charred)	From bark floor	HC on site
4362	wood (charred)	From bark floor	HC on site
3995	charcoal?	EBK-cultural layer	HC on site
4549	charcoal?	EBK-cultural layer	HC on site
4686	wood	Over bark floor (sch. 37a)	HC on site
7960	wood (worked stake pos. horizontally)	Cultural layer III	single-fronted cores in layers III and IV (no drawings/ photos available)
7605	bone (*Alces alces*, cranium, frag)	Cultural layer III	single-fronted cores in layers III and IV (no drawings/ photos available)
8737	wood (worked)	Cultural layer IV	single-fronted cores in layers III and IV (no drawings/ photos available)
8561	wood (worked)	Cultural layer IV	single-fronted cores in layers III and IV (no drawings/ photos available)
8566	wood (worked)	Cultural layer IV	single-fronted cores in layers III and IV (no drawings/ photos available)
8360	wood (worked)	Cultural layer IV	single-fronted cores in layers III and IV (no drawings/ photos available)
8561	wood (*Betula*, log)	Cultural layer IV	single-fronted cores in layers III and IV (no drawings/ photos available)
8482	antler (*Alces alces*)	Cultural layer IV	single-fronted cores in layers III and IV (no drawings/ photos available)
8259	bone (*Alces alces*, mandibula)	Cultural layer IV	single-fronted cores in layers III and IV (no drawings/ photos available)
5718	bone	UNKNOWN	HC on site
5217	bone (metapodium)	UNKNOWN	HC on site
5672	charcoal (deciduae)	Layer 6	HC in the same cultural layer
5738	bone (*Cervus elaphus*)	Layer 7	HC in the same cultural layer
5768	bone (*Cervus elaphus*?)	Layer 7	HC in the same cultural layer
5843	charcoal (deciduae)	Layer 6	HC in the same cultural layer
5842	bone (*Cervus elaphus*)	Layer 7	HC in the same cultural layer
6080	charcoal	Layer 6	HC in the same cultural layer
5926	charcoal (deciduae)	Layer 6	HC in the same cultural layer
6023	pressure tool - bone??	?	handle core on site
6076	charcoal	?	handle core on site
6029	charcoal	Pit C	handle core on site
5918	R-Axt ??	?	handle core on site
6002	R-Axt, ornamentiert ??	?	handle core on site
5848	bone (reindeer)	?	handle core on site
5659	R-Axt, ornamentiert ??	?	handle core on site
5896	R-Axt ??	?	handle core on site
5805	bone (xx) - artefact	?	handle core on site
5669	bone (bovine)	?	handle core on site
5739	R-Axt ??	?	handle core on site

Site	Country, area	Source	Sample name	BP	BP error	Cal BC (2σ) start
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KIA-272	6880	40	5878
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	OxA-6583	6735	65	5739
Seedorf LA 296	Germany, S-H	excavation documentation; Bokelmann 1995 Offa	KI-3947-9	6340	45	5469
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; Zhilin and Matiskainen 2003	KIA-35155	8315	48	7513
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	GIN-8853	8540	60	7712
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	GIN-8856	8670	50	7935
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	GIN-8854	8700	70	8160
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	KIA-35158	8799	44	8182
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	KIA-35157	8860	47	8227
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	GIN-11093a	8850	90	8248
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	GIN-8375	9220	60	8611
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	GrA-34084	9310	60	8732
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	KIA-35156	9383	42	8776
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	KIA-35154	9413	50	9042
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	AAR-22231	9426	43	9042
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	KIA-35153	9505	47	9126
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	KIA-39316	9554	43	9150
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	AAR-22232	9597	43	9215

Cal BC (2σ) end	Sample material	Context of date	Ass. Find
5669	bone (reindeer) - artefact	?	handle core on site
5486	bone (pig/boar) - ornamented	?	handle core on site
5213	charcoal	?	handle core on site
7188	bone (*Alces alces*, artefact)	Cultural layer III, square 290	single-fronted cores in cultural layer
7482	wood (*Betula*, stake)	Driven from layer III into lakle bottom, square m 53	single-fronted cores in cultural layer
7587	wood (*Betula*, stake)	Driven from layer III into lakle bottom, square m 76	single-fronted cores in cultural layer
7586	wood (*Betula*, stake)	Driven from layer III into lakle bottom, square m	single-fronted cores in cultural layer
7614	bone (*Alces alces*, artefact)	Cultural layer III, square m 265	single-fronted cores in cultural layer
7800	wood (artefact)	Cultural layer III, square m 293	single-fronted cores in cultural layer
7614	bone (*Alces alces*, unworked)	Cultural layer III, square m 175	single-fronted cores in cultural layer
8295	wood (*Betula*, stake)	Driven from layer III into lakle bottom, square m 32	single-fronted cores in cultural layer
8343	bone (*Homo sapiens*)	Cultural layer III	single-fronted cores in cultural layer
8551	bone (*Alces alces*, artefact)	Cultural layer III, square m 484	single-fronted cores in cultural layer
8554	bone (*Alces alces*, artefact)	Cultural layer III, square m 21	single-fronted cores in cultural layer
8564	bone (*Alces alces*, artefact)	Cultural layer III, square m 293	single-fronted cores in cultural layer
8638	wood (artefact)	Cultural layer IV, square m 302	single-fronted cores in cultural layer
8758	bone (*Alces alces*, artefact)	Cultural layer IV, square m 191	single-fronted cores in cultural layer
8812	antler (*Alces alces*, artefact)	Cultural layer IV, Square 157, depth 182	single-fronted cores in cultural layer

Site	Country, area	Source	Sample name	BP	BP error	Cal BC (2σ) start
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	KIA-39317	9741	40	9296
Stanovoye 4	Russia, Upper Volga Region	Hartz *et al.* 2010; Philippsen 2019; Söderlind and Zhilin 2021; Zaretskaya *et al.* 2005; Zhilin 2002; 2009; Zhilin and Matiskainen 2003	KIA-35152	9879	50	9651
Stanovoye 4	Russia, Upper Volga Region	new date	KIA-53778	9855	50	9447
Stanovoye 4	Russia, Upper Volga Region	new date	KIA-53779	10135	55	9991
Stanovoye 4	Russia, Upper Volga Region	new date	KIA-53780	8975	50	8289
Stanovoye 4	Russia, Upper Volga Region	new date	KIA-53781	9005	45	8297
Stokke-Polland 8	Norway, Vestfold og Telemark	Fossum, G. 2017	Ua-51840	6215	35	5302
Stormossen 1	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-23135	5760	60	4774
Stormossen 1	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-23348	5715	55	4711
Stormossen 1	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-24225	5740	55	4713
Stormossen 1	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-24226	5380	50	4339
Stormossen 5	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-22436	6270	65	5373
Stormossen 5	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-22437	5800	45	4784
Stormossen 5	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-22438	6025	60	5204
Stormossen 5	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-22439	5905	50	4394
Stormossen 5:2	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-22440	6275	60	5372
Stormossen 5:2	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-22441	5810	50	4790
Stormossen 5:2	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-22442	5985	60	5024
Stormossen 5:2	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-22443	5760	60	4774
Stormossen 5:2	Sweden, Uppland	Guinard, M. and Vogel, P. 2006	Ua-32523	5745	45	4709
Storsand R54	Norway, Viken	Ballin, T.B. 1998	β-110232	6460	50	5516
Storsand R54	Norway, Viken	Ballin, T.B. 1998	β-110233	6450	50	5510
Svartkärret 1	Sweden, Närke	Darmark, K. *et al.* 2009.	Ua-35078	7615	55	6594
Svartkärret 1	Sweden, Närke	Darmark, K. *et al.* 2009.	Ua-35076	7650	55	6636
Svartkärret 1	Sweden, Närke	Darmark, K. *et al.* 2009.	Ua-35075	7660	55	6637
Svartkärret 1	Sweden, Närke	Darmark, K. *et al.* 2009.	Ua-23473	7750	55	6685
Svartkärret 1	Sweden, Närke	Darmark, K. *et al.* 2009.	Ua-35077	7800	55	6813
Svartkärret 3	Sweden, Närke	Darmark, K. *et al.* 2009.	Ua-23494	7320	65	6373
Svartkärret 3	Sweden, Närke	Darmark, K. *et al.* 2009.	Ua-23496	7385	65	6392
Svartkärret 3	Sweden, Närke	Darmark, K. *et al.* 2009.	Ua-38389	7531	48	6464
Svartkärret 3	Sweden, Närke	Darmark, K. *et al.* 2009.	Ua-38390	7655	61	6640
Tågerup 1:1 - SU6	Sweden, Scania	Kjällquist, M. 2001	Ua-9946	7495	75	6475
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25193	5070	70	4036
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25191	5700	70	4708
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9953	6365	75	5480
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9952	6420	80	5528
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9950	6440	75	5552
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9955	6460	70	5604
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9947	6490	75	5615
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9954	6485	90	5620
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9948	6550	70	5624
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9949	6655	70	5711

Cal BC (2σ) end	Sample material	Context of date	Ass. Find
8949	antler (*Alces alces*, artefact)	Cultural layer IV, square m 95	single-fronted cores in cultural layer
9247	bone (*Alces alces*, artefact)	Cultural layer IV, square. m 173	single-fronted cores in cultural layer
9242	antler (*Alces alces*)	Cultural layer IV, Square 157, depth 182. trench 3.	single-fronted cores in cultural layer
9454	antler (*Alces alces*)	Cultural layer IV, Square 9, depth 180. trench 3.	single-fronted cores in cultural layer
7961	bone, mandible (Castor fiber)	Cultural layer IV, Square 165, depth 140. trench 3.	single-fronted cores in cultural layer
7973	bone, mandible (Castor fiber)	Cultural layer III, Square 160, depth 168-172. trench 3.	single-fronted cores in cultural layer
5047	charcoal (*Betula*)	Hearth/cooking pit (Feature 24210), Area B	HC and related finds within 1,5 meters of hearth
4456	bone (Pinnipedia)	Square 4450	one HC (in quartz), possible HC preform (in porphyry) on the same site
4446	bone (*Pusa hispida*)	Square 14263	one HC (in quartz), possible HC preform (in porphyry) on the same site
4456	charcoal (*Pinus*)	Feature (A) 14356, cooking pit	one HC (in quartz), possible HC preform (in porphyry) on the same site
4054	charcoal (*Pinus*, branch w 15 year rings)	Feature (A) 14298, cooking pit	one HC (in quartz), possible HC preform (in porphyry) on the same site
5045	bone (Pinnipedia?)	Feature (A) 4051, cooking pit	two HC in Tuff on the site, possibly near feature 2260
4541	hazelnut shell (burnt)	Feature (A) 4051, cooking pit	two HC in Tuff on the site, possibly near feature 2260
4730	bone (Pinnipedia)	Feature (A) 2260, hearth	two HC in Tuff on the site, possibly near feature 2260
4620	hazelnut shell (burnt)	Feature (A) 2260, hearth	two HC in Tuff on the site, possibly near feature 2260
5053	bone (Pinnipedia)	Feature (A) 3507, cooking pit	one HC in quartz on site
4542	hazelnut shell (burnt)	Square (R) 4949, rel. to cooking pit 6384	one HC in quartz on site
4720	hazelnut shell (burnt)	Feature (A) 6343, pit	one HC in quartz on site
4456	bone (Pinnipedia?)	Feature (A) 6343, pit	one HC in quartz on site
4461	hazelnut shell (burnt)	Feature (A) 6343, pit	one HC in quartz on site
5318	charcoal	Occupational layer	HC and many microblades on site
5313	charcoal	Occupational layer	HC and many microblades on site
6391	hazelnut shell (burnt)	UNKNOWN	HC and blades on site
6417	hazelnut shell (burnt)	UNKNOWN	HC and blades on site
6424	hazelnut shell (burnt)	UNKNOWN	HC and blades on site
6464	hazelnut shell (burnt)	UNKNOWN	HC and blades on site
6473	hazelnut shell (burnt)	UNKNOWN	HC and blades on site
6035	hazelnut shell (burnt)	UNKNOWN	HC and blades on site
6084	hazelnut shell (burnt)	UNKNOWN	HC and blades on site
6251	hazelnut shell (burnt)	UNKNOWN	HC and blades on site
6417	hazelnut shell (burnt)	UNKNOWN	HC and blades on site
6104	charcoal	Grave 1, A6258	HC in grave
3657	bone (*Sus scrofa*, femur)	Layer 4 - Kongemose layer	HC in cultural layer
4367	bone (*Sus scrofa*, fibula)	Layer 6 - Ertebølle layer	HC in cultural layer
5130	wood (pointed pole)	Layer 6 - Ertebølle layer	HC in cultural layer
5216	wood (trunk frag.)	Layer 6 - Ertebølle layer	HC in cultural layer
5220	wood (fishing structure 2)	Layer 6 - Ertebølle layer	HC in cultural layer
5230	wood (fishing structure 12)	Layer 6 - Ertebølle layer	HC in cultural layer
5314	wood (fishing structure 1)	Layer 6 - Ertebølle layer	HC in cultural layer
5226	wood (shaft for pressure tool)	Layer 6 - Ertebølle layer	HC in cultural layer
5374	wood (arrow)	Layer 6 - Ertebølle layer	HC in cultural layer
5477	wood (axe shaft)	Layer 6 - Ertebølle layer	HC in cultural layer

Site	Country, area	Source	Sample name	BP	BP error	Cal BC (2σ) start
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25210	6690	80	5721
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9936	6785	60	5792
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25214	6770	70	5802
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	LuA-4637	6700	110	5838
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9951	6880	65	5964
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25196	7140	65	6216
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25216	7185	60	6221
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25211	7225	65	6229
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25208	7225	75	6236
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-8635 double date?	7270	65	6329
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9938	7290	75	6368
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9937	7345	60	6375
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	LuA-4638	7260	100	6376
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25190	7355	65	6377
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9956	7355	75	6390
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25195	7335	85	6392
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25203	7385	80	6410
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-8365	7380	90	6419
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25215	7415	60	6420
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25204	7405	85	6421
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25197	7415	80	6424
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25202	7420	65	6424
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25186	7430	65	6431
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25209	7430	80	6433
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25192	7440	65	6436
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9943	7435	85	6437
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-8635	7460	70	6456
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25188	7510	65	6462
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9939	7470	80	6466
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25207	7470	90	6468
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9941	7480	80	6472
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25213	7515	80	6566
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25212	7575	75	6589
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25201	7595	70	6595
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25187	7605	65	6598
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9940	7610	85	6640
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9942	7615	90	6643
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25194	7670	75	6648
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25189	7645	80	6649
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25205	7745	65	6692
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25200	7760	65	6767
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25198	7740	80	6774
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25199	7740	80	6774
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-9944	7810	95	7034
Tågerup 1:1 - SU6	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25206	8095	90	7340
Tågerup 1:1 - SU7	Sweden, Scania	Mårtensson, J. 1999	Ua-25116	5905	75	4988
Tågerup 1:1 - SU7	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25185	6025	55	5203
Tågerup 1:1 - SU7	Sweden, Scania	Mårtensson, J. 1999	Ua-8369	6315	65	5472
Tågerup 1:1 - SU7	Sweden, Scania	Karsten, P. and Knarrström, B. 2001	Ua-25184	6370	60	5475

Cal BC (2σ) end	Sample material	Context of date	Ass. Find
5481	bone (*Sus scrofa*, astragalus)	Layer 4 - Kongemose layer	HC in cultural layer
5566	antler (*Cervus elaphus*)	Layer 6 - Ertebølle layer	HC in cultural layer
5554	bone (*Cervus elaphus*, calacaneus)	Layer 4 - Kongemose layer	HC in cultural layer
5411	bone (*Cervus elaphus*, metatarsal)	Layer 6 - Ertebølle layer	HC in cultural layer
5637	wood (*Betula*, bark)	Layer 4 - Kongemose layer	HC in cultural layer
5847	bone (*Sus scrofa*, astragalus)	Layer 4 - Kongemose layer	HC in cultural layer
5921	bone (*Capreolus capreolus*, tibia)	Layer 4 - Kongemose layer	HC in cultural layer
5988	bone (*Sus scrofa*, astragalus)	Layer 4 - Kongemose layer	HC in cultural layer
5924	bone (*Canis familiaris*, mandibula)	Layer 4 - Kongemose layer	HC in cultural layer
6002	bone	Layer 110, Fu.	UNKNOWN
6013	antler (*Cervus elaphus*)	Layer 6 - Ertebølle layer	HC in cultural layer
6071	antler (*Cervus elaphus*)	Layer 4 - Kongemose layer	HC in cultural layer
5923	bone (*Capreolus capreolus*, metatarsal)	Layer 4 - Kongemose layer	HC in cultural layer
6074	bone (*Sus scrofa*, tibia)	Layer 4 - Kongemose layer	HC in cultural layer
6070	bone (*Capreolus capreolus*, scapula)	Layer 4 - Kongemose layer	HC in cultural layer
6031	bone (*Sus scrofa*, astragalus)	Layer 6 - Ertebølle layer	HC in cultural layer
6077	bone (*Canis lupus*, metatarsal 5)	Layer 4 - Kongemose layer	HC in cultural layer
6071	bone	Layer 111, Fu.	UNKNOWN
6089	bone (*Sus scrofa*, coxae)	Layer 4 - Kongemose layer	HC in cultural layer
6082	bone (*Halichoerus grypus*, ulna)	Layer 4 - Kongemose layer	HC in cultural layer
6086	bone (*Homo sapiens*, femur)	Layer 4 - Kongemose layer	HC in cultural layer
6089	bone (*Sus scrofa*, mandibula)	Layer 4 - Kongemose layer	HC in cultural layer
6090	bone (*Ursus arctos*, metacarpal 4)	Layer 4 - Kongemose layer	HC in cultural layer
6087	bone (*Cervus elaphus*, metatarsal)	Layer 4 - Kongemose layer	HC in cultural layer
6091	bone (*Canis familiaris*, radius)	Layer 4 - Kongemose layer	HC in cultural layer
6086	bone (Cervidae, ulna)	Layer 4 - Kongemose layer	HC in cultural layer
6094	antler (*Cervus elaphus*)	Layer 108, Fu.	UNKNOWN
6237	bone (*Ursus arctos*, scapula)	Layer 4 - Kongemose layer	HC in cultural layer
6090	antler + bone (*Cervus elaphus*, cranium)	Layer 4 - Kongemose layer	HC in cultural layer
6088	bone (*Canis familiaris*, coxae)	Layer 4 - Kongemose layer	HC in cultural layer
6091	bone (*Cervus elaphus*, metacarpal)	Layer 4a	UNKNOWN
6106	bone (*Sus scrofa*, astragalus)	Layer 4 - Kongemose layer	HC in cultural layer
6247	bone (*Sus scrofa*, astragalus)	Layer 4c	UNKNOWN
6258	bone (*Cervus elaphus*, metacarpal)	Layer 4 - Kongemose layer	HC in cultural layer
6264	bone (*Cervus elaphus*, tibia)	Layer 4 - Kongemose layer	HC in cultural layer
6256	bone (*Homo sapiens*, cranium)	Layer 4 - Kongemose layer	HC in cultural layer
6256	bone (*Sus scrofa*, astragalus)	Layer 4b	UNKNOWN
6408	bone (*Canis familiaris*, femur)	Layer 4 - Kongemose layer	HC in cultural layer
6273	bone (*Cervus elaphus*, metapod)	Layer 4 - Kongemose layer	HC in cultural layer
6451	bone (*Phoca* indet., tibia)	Layer 4 - Kongemose layer	HC in cultural layer
6452	bone (*Canis familiaris*, radius)	Layer 4 - Kongemose layer	HC in cultural layer
6426	bone (*Bos primigenius*, Carple 2+3)	Layer 4 - Kongemose layer	HC in cultural layer
6426	bone (*Sus scrofa*, humerus)	Layer 4 - Kongemose layer	HC in cultural layer
6463	bone (*Canis familiaris*, metacarpal 4)	Layer 4 - Kongemose layer	HC in cultural layer
6698	bone (*Halichoerus grypus*, cranium)	Layer 4 - Kongemose layer	HC in cultural layer
4556	bone (*Sus scrofa*, tibia)	Refuse layer 22	HC in refuse layer
4784	bone (*Sus scrofa*, calcaneus)	Layer 103, Fu.	UNKNOWN
5072	charcoal	Cultural layer 20	HC in cultural layer
5217	bone (*Sus scrofa*, ulna)	Refuse layer 22	HC in refuse layer

Site	Country, area	Source	Sample name	BP	BP error	Cal BC (2σ) start
Tågerup 1:1 - SU7	Sweden, Scania	Mårtensson, J. 1999	Ua-8370	6375	70	5476
Tågerup 1:1 - SU7	Sweden, Scania	Mårtensson, J. 1999	Ua-25119	6440	85	5608
Tågerup 1:1 - SU7	Sweden, Scania	Mårtensson, J. 1999	Ua-25117	6505	75	5617
Tågerup 1:1 - SU7	Sweden, Scania	Mårtensson, J. 1999	Ua-25118	6700	85	5734
Torpum 9A	Norway, Viken	Glørstad, H. 2003	Tua-3286	6940	75	5985
Torpum 9A	Norway, Viken	Glørstad, H. 2003	Tua-3229	7015	75	6019
Torpum 9A	Norway, Viken	Glørstad, H. 2003	Tua-3227	7180	80	6228
Torpum 9A	Norway, Viken	Glørstad, H. 2003	Tua-3919	7010	45	5990
Torpum 9A	Norway, Viken	Glørstad, H. 2003	Tua-3228	6975	90	6021
Torpum 9A	Norway, Viken	Glørstad, H. 2003	Tua-3890	6885	50	5887
Torpum 9A	Norway, Viken	Glørstad, H. 2003	Tua-3892	6430	55	5481
Torpum 9B	Norway, Viken	Glørstad, H. 2003	TUa-3921	5270	45	4239
Torpum 9B	Norway, Viken	Glørstad, H. 2003	TUa-3920	6205	85	5359
Torpum 9B	Norway, Viken	Glørstad, H. 2003	TUa-3234	6250	85	5468
Torpum 9B	Norway, Viken	Glørstad, H. 2003	TUa-3935	6365	45	5473
Torpum 9B	Norway, Viken	Glørstad, H. 2003	Tua-3280	6325	75	5474
Torpum 9B	Norway, Viken	Glørstad, H. 2003	Tua-3233	6375	75	5481
Torpum 9B	Norway, Viken	Glørstad, H. 2003	Tua-3931	6380	40	5474
Torpum 9B	Norway, Viken	Glørstad, H. 2003	Tua-3933	6420	40	5475
Torpum 9B	Norway, Viken	Glørstad, H. 2003	Tua-3937	6435	45	5477
Torpum 9B	Norway, Viken	Glørstad, H. 2003	Tua-3934	6435	40	5476
Torpum 9B	Norway, Viken	Glørstad, H. 2003	Tua-3936	6495	40	5536
Torpum 9B	Norway, Viken	Glørstad, H. 2003	Tua-3922	6505	55	5613
Torpum 9B	Norway, Viken	Glørstad, H. 2003	Tua-3279	6530	70	5622
Trosterud lok 1	Norway, Viken	Berg, E. 1997	Tua-1549	7745	75	6769
Trosterud lok 1	Norway, Viken	Berg, E. 1997	Tua-1548	7435	75	6435
Ust-Tudovka 4	Russia, Upper Volga Region	from Zhilin folder: 1996_Wes Rus fin…	GIN-4947	9190	100	8700
Ust-Tudovka 4	Russia, Upper Volga Region	from Zhilin folder: 1996_Wes Rus fin…	Gin-4864	8770	200	8422
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-3523	5070	90	4044
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-3522	5680	95	4722
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-5772	5720	115	4831
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Frandsen, B.Ø. 2015	K-5773	6030	75	5207
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-3521	6230	100	5469
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-4963	6440	100	5613
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-3518	6810	105	5971
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-3519	6910	105	5989
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-3520	6990	80	6014
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-4970	7060	105	6213
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-2909	7200	110	6364
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-2908	7230	110	6375
Vænget Nord	Denmark, Zealand	Brinch Petersen, E. 2015; Øland Frandsen, B. 2015	K-2907	7350	110	6422

Cal BC (2σ) end	Sample material	Context of date	Ass. Find
5216	charcoal	Refuse layer 22	HC in refuse layer
5218	hazelnut shell	Pit	HC adjacent to the pit, less than 1 meter
5321	bone (*Cervus elaphus*, humerus)	Refuse layer 22	HC in refuse layer
5478	charcoal	Cultural layer 21	HC on site
5672	charcoal (*Salix*, *Populus*)	Feature (A)22, hearth, W part of area	13 HC on site
5738	hazelnut shell (burnt)	Feature (A)11, hearth, W part of area	13 HC on site
5896	hazelnut shell (burnt)	Feature (A)9, hearth, W part of area	13 HC on site
5771	hazelnut shell (burnt)	Feature (A)203, hearth, W part of area	13 HC on site
5673	hazelnut shell (burnt)	Feature (A)10, hearth, W part of area	13 HC on site
5665	charcoal (*Prunus*, *Sorbus*)	Feature (A)203b, hearth, W part of area	13 HC on site
5229	charcoal (*Quercus*)	Feature (A)502, hearth, W part of area	13 HC on site
3982	charcoal (*Betula, Corylus*)	Feature (A)6, pit	HC on site
4939	charcoal (*Ulmus*, *Fraxinus*)	Feature (A)1, pit	HC incl. in nearby flint concentration
4992	hazelnut shell	Cultural layer, x51y51, SV	HC on site
5218	hazelnut shell	Feature (A)7a, hearth	HC incl. in nearby flint concentration
5072	charcoal (*Salix*, *Populus*)	Feature (A)2, cultural layer	HC incl. in nearby flint concentration
5208	hazelnut shell	Feature (A)2, cultural layer	HC incl. in nearby flint concentration
5223	hazelnut shell	Feature (A)5, hearth	HC on site
5320	hazelnut shell	Feature (A)13, hearth	HC incl. in nearby flint concentration
5322	hazelnut shell	Feature (A)2c, hearth	HC incl. in nearby flint concentration
5326	hazelnut shell	Feature (A)7b, pit	HC incl. in nearby flint concentration
5366	hazelnut shell	Feature (A)2a, hearth	HC incl. in nearby flint concentration
5361	charcoal (*Betula*)	Feature (A)4, pit	HC on site
5362	charcoal (*Quercus*)	Feature (A)2, cultural layer over hearth A2b	HC incl. in nearby flint concentration
6433	charcoal (*Betula*, *Corylus*, *Salix*)	Hearth 1 (x90/y45 lag 4)	one HC on site, on a separate area
6088	charcoal (*Betula*, *Corylus*, *Salix*)	Hearth 2 (x94/y49 lag 4)	one HC on site, on a separate area
8241	unknown	From under occupation layer	single fronted cores from site (recorded)
7473	unknown	Cultural layer	single fronted cores from site (recorded)
3651	wood (charred)	UNKNOWN	HC on site
4345	wood	UNKNOWN	HC on site
4346	wood	UNKNOWN	HC on site
4725	wood	UNKNOWN	HC on site
4912	wood (charred)	UNKNOWN	HC on site
5216	wood (artefact)	UNKNOWN	HC on site
5532	wood (worked post)	UNKNOWN	HC on site
5629	wood	UNKNOWN	HC on site
5726	wood (stub)	UNKNOWN	HC on site
5722	wood	UNKNOWN	HC on site
5841	charcoal	UNKNOWN	HC on site
5891	root	UNKNOWN	HC on site
6023	wood	UNKNOWN	HC on site

Site	Country, area	Source	Sample name	BP	BP error	Cal BC (2σ) start
Vallermyrene 1A	Norway, Vestfold og Telemark	Reitan, G. 2016	Ua-45182	5770	35	4716
Vallermyrene 1A	Norway, Vestfold og Telemark	Reitan, G. 2016	Ua-45181	5748	35	4698
Vallermyrene 1B	Norway, Vestfold og Telemark	Reitan, G. 2016	Ua-45180	5373	34	4332
Vallermyrene 4	Norway, Vestfold og Telemark	Eigeland, L. and Fossum, G. 2014.	Ua-45171	6067	41	5205
Vallermyrene 4	Norway, Vestfold og Telemark	Eigeland, L. and Fossum, G. 2014.	Ua-45172	6197	40	5299
Vallermyrene 4	Norway, Vestfold og Telemark	Eigeland, L. and Fossum, G. 2014.	Ua-45170	6381	37	5473
Vallermyrene 4	Norway, Vestfold og Telemark	Eigeland, L. and Fossum, G. 2014.	Ua-45169	6489	50	5552
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	LE-1469	9600	80	9241
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	GIN-4833	9370	80	9114
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	GIN-4031	9050	80	8536
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	LE-1472	8750	70	8171
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	GIN-2452-1	8560	120	8164
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	GIN-2452-2	8552	130	8168
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	GIN-4030	8520	80	7737
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	GIN-4832	8340	120	7585
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	LE-1470	8270	100	7522
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	LE-1471	7960	100	7138
Veretye 1	Russia, Upper Volga Region	Oshibkina, S.V. 2006.	LE-1473	7700	80	6689
Zolotoruchye 1	Russia, Upper Volga Region	Zhilin, M.G. 2007; Hartz, S. *et al.* 2010	KIA-39314	10240	37	10469
Zolotoruchye 1	Russia, Upper Volga Region	Zhilin, M.G. 2007; Hartz, S. *et al.* 2010	KIA-39315	9990	62	9788

Cal BC (2σ) end	Sample material	Context of date	Ass. Find
4507	charcoal (*Pinus*)	Feature (A)322, hearth	one HC on site, different area
4498	charcoal (*Pinus*)	Feature (A)301, cooking pit/hearth	one HC on site, different area
4058	charcoal (*Betula*)	Feature (A)391, cooking pit/hearth	one HC on site, same area but further than 2-3 meter away
4841	charcoal (*Pinus*)	Area B / Feature A 869	HC found within 3 meters from the feature, microblades found on site
5030	charcoal (*Pinus*)	Area B / Feature A 869	HC found within 3 meters from the feature, microblades found on site
5225	bone (Mammalia indet., burnt)	Area A, x892/y243, NV/3	one HC found on this area and many microblades
5331	bone (Mammalia indet., burnt)	Area A, x894/y242, NO/1	one HC found on this area and many microblades
8758	charcoal	UNKNOWN	single-fronted cores on site
8343	antler (tool?)	UNKNOWN	single-fronted cores on site
7960	charcoal	UNKNOWN	single-fronted cores on site
7595	wood	UNKNOWN	single-fronted cores on site
7327	charcoal	UNKNOWN	single-fronted cores on site
7195	wood	UNKNOWN	single-fronted cores on site
7365	charcoal	UNKNOWN	single-fronted cores on site
7077	antler (tool?)	UNKNOWN	single-fronted cores on site
7068	charcoal	UNKNOWN	single-fronted cores on site
6596	charcoal	UNKNOWN	single-fronted cores on site
6417	wood	UNKNOWN	single-fronted cores on site
9810	bone (*Bison priscus*)	From cluster 5, lower layer	single-fronted cores in cluster 2, cluster 4, cluster 5
9310	charcoal	Fireplace by concentration 3	single-fronted cores on site

ROOTS Studies

The book series ‘ROOTS Studies’ presents scientific research that proceeds from the implementation of individual and cross-disciplinary projects within the Cluster of Excellence ‘ROOTS – Social, Environmental and Cultural Connectivity in Past Societies’ at Kiel University. The series addresses social, environmental, and cultural phenomena as well as processes of past human development in light of the key concept of ‘connectivity’. The results of specific research topics and themes across various formats, including monographs, edited volumes, proceedings of conferences and workshops as well as data collections, are the backbone of this book series.

The **Cluster of Excellence ROOTS** explores the roots of social, environmental, and cultural phenomena and processes that substantially marked past human development. In a broad interdisciplinary conceptual framework, archaeological and historical ‘laboratories’ are investigated under the basic assumption that humans and environments have deeply shaped each other, creating socio-environmental connectivities, which still persist today. A better understanding of interwoven past socio-environmental dynamics will shed light on the ‘roots’ of current challenges and crises under diverse economic, ecological, and social conditions.

An important objective of ROOTS is the transfer of knowledge. This is achieved through the volumes of the ROOTS book series, which serve as one mirror of the coordinated concern of ROOTS researchers and their partners. ROOTS researchers explore the human-environmental relationship over a plurality of spatial and temporal scales within past societies and environments. The associated research challenges revolve around the premise that humans and environments have interwoven roots, which reciprocally influence each other, stemming from and yielding connectivities that can be identified and juxtaposed against current social issues and crises. The highly dynamic research agenda of the ROOTS cluster, its diverse research strands and state of the art research set the stage for interdisciplinary results, which are published in the volumes of this book series.

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The Handle Core Concept

Lithic Technology and Knowledge Transmisson in Mesolithic Northern Europe

This work deals with topics related to mobility, contacts and transmission of knowledge. The study of these topics regarding the past can promote an understanding of the social implications of migration, communication and learning today through long-term perspectives of change. This volume focuses on these topics in the Mesolithic by analysing a specialised lithic concept known previously from Scandinavia and Northern Germany. The implementation of the *Handle Core Pressure Concept* (HCPC) is based on a pressure technique to produce small regular blades from single-fronted cores, often utilised in slotted bone points. The use of pressure technique means that the HCPC requires social learning for maintenance and diffusion of the tradition.

The research questions focus on three aspects of the HCPC: *technology, chronology* and the *transmission of knowledge* that are involved in the diffusion process. Materials from across Northern Europe have been studied and analysed. The results show that the morphology of the materials is similar across Europe, but that there are differences in the technological choices made by knappers in different parts of the area. These variations relate to the core preparation. The technological differences are also connected to two different chronologies that are centred east and west of the Baltic Sea, which would indicate two separate technological and social traditions.

The cores east of the Baltic Sea still require more research in order to understand how they relate to other concepts in and around Northern Europe. The cores from Scandinavia, however, exhibit strong technological similarities to an older pressure-based blade concept that was already used in Scandinavia in the Early Mesolithic. The long-term use and the rapid diffusion of the HCPC indicate that knowledge and know-how must have diffused via both vertical and horizontal directionalities. These results exemplify the complex ways that mobility, social learning, material availability, tradition and many other aspects played a role in the transmission of knowledge in Mesolithic societies.

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