

Daniel Groß · Harald Lübke · John Meadows · Detlef Jantzen (eds.)

# Working at the Sharp End: From Bone and Antler to Early Mesolithic Life in Northern Europe



10

Untersuchungen und Materialien  
zur Steinzeit in Schleswig-Holstein  
und im Ostseeraum

UNTERSUCHUNGEN UND MATERIALIEN ZUR STEINZEIT  
IN SCHLESWIG-HOLSTEIN UND IM OSTSEERAUM

BAND 10

Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein und im Ostseeraum  
aus dem Museum für Archäologie Schloss Gottorf und dem Zentrum für Baltische und Skandinavische  
Archäologie  
in der Stiftung Schleswig-Holsteinische Landesmuseen Schloss Gottorf  
Band 10

Begründet von  
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Herausgegeben von  
Sönke Hartz und Harald Lübke

Working at the Sharp End:  
From Bone and Antler to Early Mesolithic  
Life in Northern Europe

Daniel Groß, Harald Lübke, John Meadows and Detlef Jantzen (eds.)

***Wachholtz***





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Laserscan of the wooden sign that was attached to the excavation hut during the Hohen Viecheln excavations ('To the sharp harpoon'; Laserscan: J. Nowotny, ZBSA).



# CONTENTS

Vorwort der Herausgeber . . . . .	9
Editors' Preface . . . . .	11
Grußwort des Landesarchäologen von Mecklenburg-Vorpommern . . . . .	12
Welcome address by the State Archaeologist of Mecklenburg-Western Pomerania. . . . .	13
Acknowledgements . . . . .	14
<i>Daniel Groß, Harald Lübke, John Meadows, Detlef Jantzen and Stefan Dreibrodt</i> Re-evaluation of the site Hohen Viecheln 1 . . . . .	15
<i>John Meadows, Mathieu Boudin, Daniel Groß, Detlef Jantzen, Harald Lübke and Markus Wild</i> Radiocarbon dating bone and antler artefacts from Mesolithic Hohen Viecheln (Mecklenburg-Western Pomerania, Germany) . . . . .	113
<i>Éva David</i> The osseous technology of Hohen Viecheln: a Maglemosian idiosyncrasy? . . . . .	127
<i>Markus Wild</i> An evaluation of the antler headdress evidence from Hohen Viecheln . . . . .	163
<i>Erik Brinch Petersen</i> Nordic visits to Hohen Viecheln, Mecklenburg. . . . .	179
<i>Bernhard Gramsch</i> The Mesolithic bone industries of northeast Germany and their geo-archaeological background . . . . .	193
<i>Sönke Hartz, Harald Lübke and Daniel Groß</i> Early Mesolithic bone points from Schleswig-Holstein . . . . .	203
<i>Ulrich Schmölcke</i> Early Mesolithic hunting strategies for red deer, roe deer and wild boar at Friesack 4, a three-stage Preboreal and Boreal site in Northern Germany. . . . .	239
<i>Lars Larsson, Arne Sjöström and Björn Nilsson</i> Lost at the bottom of the lake. Early and Middle Mesolithic leister points found in the bog Rönneholms Mosse, southern Sweden . . . . .	255

<i>Sara Gummesson and Fredrik Molin</i> Points of bone and antler from the Late Mesolithic settlement in Motala, eastern central Sweden . . . . .	263
<i>Harry K. Robson and Kenneth Ritchie</i> The Early Mesolithic fisheries of Southern Scandinavia . . . . .	289
<i>Ilga Zagorska</i> The Early Mesolithic bone and antler industry in Latvia, Eastern Baltic. . . . .	305
<i>Mikhail G. Zhilin</i> Early Mesolithic barbed bone points in the Volga-Oka interfluvium . . . . .	319
<i>Olga Lozovskaya and Vladimir Lozovski†</i> Bone and antler projectile points from the Meso-Neolithic site Zamostje 2, Moscow region, Russia . . . . .	341
<i>Svetlana Savchenko</i> Early Mesolithic bone projectile points of the Urals . . . . .	367
<i>Luc Amkreutz and Merel Spithoven</i> Hunting beneath the waves. Bone and antler points from North Sea Doggerland off the Dutch coast . . . . .	383
<i>Barry Taylor, Nicky Milner and Chantal Conneller</i> Excavations at Star Carr: past and present. . . . .	405
<i>Ben Elliott, Barry Taylor, Becky Knight, Nicky Milner, Harry K. Robson, Diederik Pomstra, Aimée Little and Chantal Conneller</i> Understanding the bone and antler assemblages from Star Carr . . . . .	419

# VORWORT DER HERAUSGEBER

Die Schriftenreihe „Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein“ wurde von dem ursprünglichen Herausgeber Jürgen Hoika vor mittlerweile 25 Jahren im Jahre 1994 begründet, um am damaligen Archäologischen Landesmuseum Schleswig (ALM) und heutigem Museum für Archäologie Schloss Gottorf (MfA) ein Publikationsorgan für die Veröffentlichung von Forschungsergebnissen zur Steinzeit Schleswig-Holsteins zu schaffen. Dabei sollte es sich zum einen um Sammelwerke mit Beiträgen von vorzugsweise auf Schloss Gottorf veranstalteten Symposien, Workshops und Tagungen mit steinzeitlicher Thematik und zum anderen um zumeist in Dissertationen zusammengestellte ausführliche Materialvorlagen handeln. Entsprechend enthielt der 1994 vorgelegte erste Band der Reihe die Beiträge zum 1. Internationalen Trichterbechersymposium, welches, von Jürgen Hoika gemeinsam mit Jutta Meurers-Balke initiiert, 1984 am Archäologischen Landesmuseum in Schleswig stattgefunden hatte. In der Folge wurden dann aber beginnend mit den Arbeiten der beiden heutigen Herausgeber nunmehr acht überwiegend am Institut für Ur- und Frühgeschichte der Christian-Albrechts-Universität zu Kiel fertiggestellte Dissertationen veröffentlicht, die ganz wesentlich mit der wissenschaftlichen Vorlage und Auswertung von Forschungsgrabungen in Schleswig-Holstein und – seit der Beteiligung des Zentrums für Baltische und Skandinavische Archäologie an der Herausgeberschaft – aus dem gesamten Ostseeraum befasst sind.

Deshalb ist es eine besondere Freude für die Herausgeber, mit dem vorliegenden Band 10 „Working at the Sharp End: From Bone and Antler to Early Mesolithic Life in Northern Europe“ der Schriftenreihe „Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein und im Ostseeraum“ wiederum einen Sammelband mit den Beiträgen eines Workshops vorlegen zu können, der vom 14. bis 16. März 2016 auf Schloss Gottorf stattgefunden hat. Dabei handelt es sich um den Abschlussworkshop des von der Deutschen Forschungsgemeinschaft geförderten Projektes „Neubewertung von Chronologie und Stratigraphie des frühholozänen Fundplatzes Hohen Viecheln (Mecklenburg-Vorpommern) unter besonderer Berücksichtigung der diagnostischen Knochenartefakte“ (DFG-Projektnummer 271652103) unter Leitung von Daniel Groß, Harald Lübke, John Meadows (alle ZBSA) und Detlef Jantzen (Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern; Landesarchäologie). Entsprechend enthält dieser Band neben dem Abschlussbericht des Forschungsprojektes insgesamt 17 Beiträge der eingeladenen Workshop-Teilnehmer, die entweder ergänzende Studien zum Fundplatz Hohen Viecheln enthalten oder sich grundsätzlich mit verwandten Themen zur Erforschung des frühholozänen Mesolithikums im nördlichen Europa befassen.

Alle Beiträge wurden nach internationalem Standard von jeweils zwei anonymen Gutachtern in einem Peer-review-Verfahren bewertet und danach den Autoren zur erneuten Überarbeitung übergeben, bevor die abschließende redaktionelle Bearbeitung der Manuskripte erfolgte. Die Textredaktion für alle Beiträge wurde von Gundula Lidke durchgeführt, Jana Elisa Freigang und Jorna Titel leisteten dabei unterstützende Arbeiten. Das Layout übernahm Daniel Groß, Titelbild und Umschlag entwarf Jürgen Schüller. Die meisten Karten und Zeichnungen wurden von den Autoren selbst bereitgestellt. In einzelnen Fällen erfolgte eine Überarbeitung durch Daniel Groß. Allen sei dafür an dieser Stelle herzlich gedankt.

Neu im Rahmen der Schriftenreihe ist, dass die Beiträge unmittelbar nach Fertigstellung und Freigabe der Autoren in einem „online-first“-Verfahren auf der Homepage des Verlages im Open Access zum freien Download bereitgestellt wurden. Für die Umsetzung dieser Forderung der Herausgeber danken wir dem Wachholtz Verlag, insbesondere Herrn Henner Wachholtz, sehr.

Besonderer Dank gilt dem Vorstand des Zentrums für Baltische und Skandinavische Archäologie Schleswig, besonders dem Direktor, Claus von Carnap-Bornheim, und der Forschungsleiterin, Berit Valentin Eriksen, die die Veröffentlichung dieses Bandes durch die Bereitstellung der erforderlichen Mittel für den Druck der Arbeit maßgeblich unterstützten.

Sönke Hartz und Harald Lübke  
Schleswig, im Oktober 2019

## EDITORS' PREFACE

The series 'Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein' was founded by its first editor, Jürgen Hoika, in 1994, 25 years ago, in order to establish a possibility to publish Stone Age research results from Schleswig-Holstein at the then Archaeological State Museum (Archäologisches Landesmuseum [ALM]), today's Museum for Archaeology (Museum für Archäologie, Schloss Gottorf [MfA]). Publications should, on the one hand, reflect proceedings of symposia, conferences and workshops with Stone Age topics primarily held at Gottorf Castle, on the other hand, dissertations presenting comprehensive material. According to that, the first volume, published in 1994, contained the contributions to the 1<sup>st</sup> International Funnelbeaker Symposium, which, initiated by Jürgen Hoika and Jutta Meurers-Balke, had taken place at the Archaeological State Museum in 1984. Following that, eight dissertations, mainly accomplished at the Institute for Pre- and early History at the Christian-Albrechts-University Kiel, were published, starting with those by today's editors. All these volumes contributed substantially to the scientific presentation and analysis of excavation materials from Schleswig-Holstein and – since 2012, when the Centre for Baltic and Scandinavian Archaeology (ZBSA) also became involved in editing the series – the whole of the Baltic Sea area.

Therefore the editors are especially happy to once more present conference proceedings with volume 10 of the series 'Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein und im Ostseeraum': 'Working at the Sharp End: From Bone and Antler to Early Mesolithic Life in Northern Europe' collects contributions to a workshop held at Gottorf Castle on 14<sup>th</sup>–16<sup>th</sup> March, 2016. This represented the closing workshop of the DFG-funded project 'Neubewertung von Chronologie und Stratigraphie des frühholozänen Fundplatzes Hohen Viecheln (Mecklenburg-Vorpommern) unter besonderer Berücksichtigung der diagnostischen Knochenartefakte' (DFG project no. 271652103), directed by Daniel Groß, Harald Lübke, John Meadows (all ZBSA) und Detlef Jantzen (Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern; Landesarchäologie). In addition to the project's final report the volume contains 17 papers by researchers invited to participate in the workshop, representing either additional studies on material from the site Hohen Viecheln or related topics in research of the early Holocene Mesolithic in northern Europe.

Each paper was, according to international standards, peer-reviewed by two anonymous reviewers and then returned to the author for reworking before final editorial work. Copy-editing was performed by Gundula Lide, supported by Jana Elisa Freigang and Jorna Titel. Daniel Groß realised the layout; cover and cover illustration were designed by Jürgen Schüller. Most maps and figures were provided by the authors themselves, some were reworked by Daniel Groß. We express our sincere thanks to all involved!

It is a novelty for the series to have papers published online first immediately after completion and authors' approval in open access for free download on the website of Wachholtz Publishers. We would like to thank Henner Wachholtz, Wachholtz Publishers, very much for making this possible!

Special thanks are due to the board of the Centre for Baltic and Scandinavian Archaeology (ZBSA) Schleswig, particularly to the director, Claus von Carnap-Bornheim, and the head-of-research, Berit Valentin Eriksen, who substantially supported this publication by providing financial means for its printing.

Sönke Hartz and Harald Lübke  
Schleswig, October 2019



# GRUSSWORT DES LANDESARCHÄOLOGEN VON MECKLENBURG-VORPOMMERN

Mit seinen großflächigen, oft noch weitgehend unberührten Niederungen und Binnengewässern bietet Mecklenburg-Vorpommern beste Voraussetzungen, um die gewässeraffinen Kulturen des Mesolithikums zu erforschen. Die Überreste ihrer Wohn- und Jagdstationen sind im feuchten Milieu hervorragend erhalten geblieben. Störungen durch Torfabbau, Begradigung von Gewässern oder Meliorationsmaßnahmen blieben im Wesentlichen auf das 19. und 20. Jahrhundert beschränkt. Sie haben zwar einen gewissen Schaden angerichtet, aber, weil sie zumindest im 20. Jahrhundert oft von aufmerksamen ehrenamtlichen Bodendenkmalpflegern beobachtet wurden, überhaupt erst zur Entdeckung vieler Fundstellen geführt.

Welche Fundstellen eingehender erforscht werden und damit das Bild einer Epoche besonders prägen, unterliegt oft dem Zufall. Hohen Viecheln rückte in den Fokus der Forschung, weil die Entdeckung mehrerer Knochenharpunen zu Beginn der 1950er Jahre auf eine günstige Konstellation traf: 1953 war aus der Vorgeschichtlichen Abteilung des Staatlichen Museums das Museum für Ur- und Frühgeschichte Schwerin entstanden, das auch für die Bodendenkmalpflege in den drei Nordbezirken der DDR zuständig war. Der ehrgeizige Direktor des Museums, Ewald Schuldt, hatte sich durch Ausgrabungen auf der Burgwallinsel Teterow einen Namen gemacht und war nun auf der Suche nach einem geeigneten Fundplatz für ein eigenes Forschungsprojekt.

Wegen der sehr guten Erhaltungsbedingungen versprach Hohen Viecheln, zusätzlich zu dem bekannten Spektrum an Steinartefakten auch ein umfangreiches Geräteinventar aus organischen Materialien bergen zu können. Die ebenfalls ausgezeichnet erhaltenen Tierknochen sollten Aufschluss über das Jagdwild geben. Hinzu kam die Aussicht, aus der Stratigraphie neue Erkenntnisse zur Chronologie und zu den Veränderungen der naturräumlichen Verhältnisse zu gewinnen. Diese Erwartungen wurden nicht enttäuscht: Hohen Viecheln entwickelte sich zu einem der bedeutendsten Plätze mesolithischer Forschung, gleichrangig mit Duvensee, und inspirierte weitere Forschungen, u. a. in Friesack und Rothenklempenow.

Hohen Viecheln gehört nach wie vor zu den legendären archäologischen Fundstellen in Mecklenburg-Vorpommern, auch wenn es aus heutiger Sicht nicht mehr so einzigartig dasteht. Dank einer intensiv betriebenen ehrenamtlichen Bodendenkmalpflege ist die Zahl der bekannten mesolithischen Fundplätze im Land deutlich gestiegen, von denen vermutlich mehrere ein ähnliches Potenzial wie Hohen Viecheln aufweisen. Verändert haben sich aber nicht nur die Verbreitungskarten, sondern auch die Möglichkeiten archäologischer Forschung. Es drängte sich deshalb geradezu auf, Hohen Viecheln noch einmal unter die Lupe zu nehmen, bisherige Erkenntnisse kritisch zu prüfen und neue hinzuzufügen. Der DFG und allen Projektpartnern gebührt herzlicher Dank dafür, dass sie das ermöglicht haben.

So wird Hohen Viecheln auch weiterhin als exemplarischer Fundplatz für das Mesolithikum in der norddeutschen Tiefebene stehen – eine hochinteressante Umbruchszeit, in der Klimawandel, Anstieg des Meeresspiegels und andere Veränderungen eine ständige Anpassung der Menschen an ihre Umwelt erzwangen.

Detlef Jantzen  
Schwerin, im September 2019

# WELCOME ADDRESS BY THE STATE ARCHAEOLOGIST OF MECKLENBURG-WESTERN POMERANIA

Mecklenburg-Western Pomerania with its large, often unspoiled lowlands and inland waters offers outstanding possibilities for research into the water-oriented cultural groups of the Mesolithic. Remains of their settlement and hunting sites are often well preserved in wet conditions. Disturbances by peat extraction, straightening of watercourses or melioration measures mainly took place during the 19<sup>th</sup> and 20<sup>th</sup> centuries. They did some damage, but – as at least during the 20<sup>th</sup> century they were often supervised by vigilant amateur archaeologists – many sites were discovered this way in the first place.

But often it is left to chance which sites can be thoroughly investigated to largely characterise the picture of a whole timespan. Hohen Viecheln became the focal point of research interest under favourable circumstances: the discovery of several bone points there at the beginning of the 1950s fell together with the establishment of the Museum of Pre- and Early History in Schwerin (out of the former Department of Prehistory at the State Museum) which was also responsible for the preservation and care of field monuments in the three northern districts of the GDR.

The ambitious museum director, Ewald Schuldt, had already gained reputation through his excavations of the Slavic ring wall island near Teterow, and he was looking for a suitable site for another research project. Due to the very good preservation conditions at the site, Hohen Viecheln promised, in addition to the spectrum of artefacts known from other places, a substantial organic inventory. The well-preserved animal bones were expected to shed light on game species and hunting strategies. Furthermore, important results were expected concerning chronology and environmental changes. These hopes were not disappointed: Hohen Viecheln has become, alongside Duvensee, one of the most important sites for Mesolithic research, and research there has inspired further excavations, e.g. at Friesack or Rothenklempenow.

Hohen Viecheln is still one of the legendary archaeological sites in Mecklenburg-Western Pomerania, even if it no longer stands alone. Thanks to intensive voluntary archaeological surveys the number of Mesolithic sites has increased significantly; and several of these may have a potential similar to that of Hohen Viecheln. But not only distribution maps have changed during the last years, but also the possibilities of archaeological research. Therefore, the idea to have another look at Hohen Viecheln, to challenge old results and add new ones, suggested itself. I want to thank the German Research Foundation (DFG) and all project contributors for having made this possible. In this way, Hohen Viecheln will continue to be an exemplary North German Lowland site of the Mesolithic – a highly interesting time when climate change, sea-level rise and other changes enforced constant human adaptations to the environment.

Detlef Jantzen

Schwerin, September 2019

# ACKNOWLEDGEMENTS

This volume of the series ‘Untersuchungen und Materialien zur Steinzeit in Schleswig-Holstein und im Ostseeraum’ represents the proceedings of a workshop held at the Centre for Baltic and Scandinavian Archaeology (ZBSA) in Schleswig in March 2016. It is a part of the editors’ project ‘Neubewertung von Chronologie und Stratigraphie des frühholozänen Fundplatzes Hohen Viecheln (Mecklenburg-Vorpommern) unter besonderer Berücksichtigung der diagnostischen Knochenartefakte’, funded by the German Research Foundation (DFG) under the project number 271652103.

While the project was dealing with the re-evaluation of the site Hohen Viecheln 1 for chronological and stratigraphical aspects, this volume does not only cover its final publication but comprises additional modern studies about the site by different scholars. These are furthermore embedded into the international research landscape by adjacent studies covering an area from modern day Britain in the west to the Urals in the east.

All contributions are representing the authors’ point of view and respective terminologies. Therefore differences in the vocabulary may appear to the careful reader. While a homogenisation of terms and data recording is relevant for comparative studies, it was beyond the scope and means of this project. As a consequence, terminologies may differ between the contributions, as exemplified by the terms ‘uni-serial’ and ‘uni-lateral’ bone points: both are characterised by barbs or notches on one lateral side. At the British site Star Carr those have ever since been named uni-serial, whereas uni-lateral is a more common term in other parts of Europe.

We, as editors, would like to thank all contributors for being part of this volume and their interesting and high-quality articles; also we are grateful for the voluntary support of all anonymous peer-reviewers and their help in improving the articles. Furthermore, we thank the German Research Foundation (DFG) for funding our research and the workshop as well as the Centre for Baltic and Scandinavian Archaeology represented by its director, Claus von Carnap-Bornheim, and the head-of-research, Berit Valentin Eriksen, for support of the project and its presentation in the current form. A tremendous help in the course of making this book was Gundula Lidke who was responsible for text editing, proof-reading, and correspondence with the authors and publishers. Thank you very much! Further editorial support was provided by Jana Elisa Freigang, Jorna Titel, Matthias Bolte, Isabel Sonnenschein and Jürgen Schüller. The latter is also responsible for the cover drawing. Much help and support was provided by Peter Teichert-Köster with respect to handling the finds and accessing them in the depot of the Landesamt für Kultur und Denkmalpflege Mecklenburg-Vorpommern; Landesarchäologie in Schwerin. Close collaboration with Mathieu Boudin of the Royal Institute for Cultural Heritage, Brussels, improved our radiocarbon measurements and the analysis of the consolidant.

We thank all people, mentioned and unmentioned here, who were involved in this book and the different research projects, who helped by further pushing the boundaries of our understanding of the cultural remains and chronologies of the past.

Daniel Groß, Harald Lübke, John Meadows, Detlef Jantzen  
Schleswig, October 2019

# EARLY MESOLITHIC HUNTING STRATEGIES FOR RED DEER, ROE DEER AND WILD BOAR AT FRIESACK 4, A THREE-STAGE PREBOREAL AND BOREAL SITE IN NORTHERN GERMANY

Ulrich Schmölcke

## Abstract

*During the early Holocene the Mesolithic campsites at Friesack in northern Central Europe were located on an island amidst a wetland landscape: a swampy valley rich of reeds with generally slowly flowing water (with the exception of spring), forests dominated by birch and pine, sandy hills covered with pine, and open grasslands. Due to excellent preservation conditions thousands of mammal remains could be excavated in the refuse areas of the site Friesack 4 by B. Gramsch and his team between 1978 and 1989. 826 identified mammal remains derive from the oldest, mid-Preboreal layers of the station, 1200 bones from the following late Preboreal layers, and further 3082 remains from the subsequent early Boreal horizons.*

*The main game species of the inhabitants of Friesack 4 were red deer, roe deer, and wild boar. Based on the bone weight, red deer was the most relevant and important species in all the Mesolithic stages of occupation. In the course of the c. 1500 years of habitation investigated on this site the economical relevance of wild boar increased gradually, whereas in particular elk lost its importance. Significantly, red deer hunting always focused on older juveniles or young adults.*

*Based on the number of identified specimen, remains of roe deer dominate the mammal bone assemblage in all the occupation stages, and their frequency continuously increases from the oldest to the youngest Mesolithic horizon. Roe deer hunting occurred especially in May and June and was purposefully dedicated to young females. Similarly, hunting red deer was not focussed on strong, older deer, as at some contemporaneous sites, but on young adults. Both species show that the hunter's strategy at Friesack 4 was in these cases not to get a maximum of food resources per hunting expedition, but rather to secure a successful hunt. In wild boar, in contrast, the analyses give evidence of a selective hunting of full-grown and quite old individuals, thus of wild boars for meat. Remarkably, the hunter's wild boar prey was nearly all female.*

*A résumé of all seasonal indications concerning the mammal bones shows that Mesolithic people stayed at the location nearly exclusively in the months between May and October. There is no evidence for human presence during late autumn and winter/early spring.*

*The portions of the body parts of the different game species show concordantly that the animals were slaughtered elsewhere. Friesack 4 was only the place of consumption. Partly, however, some valuable parts of the prey are missing at the campsite – potentially these parts were reserved for the successful hunters, who consumed them already at the kill site.*

# 1 Introduction

Friesack, located in the Rhinluch, a part of an ice marginal valley northwest of Berlin, is – due to excellent local preservation conditions and the enormous number of different archaeological artefacts and finds – one of the most valuable micro-regions in Central Europe with regards to Early Mesolithic habitation. Besides the neighbouring site Friesack 27a (GROSS 2017) it is Friesack 4, excavated during the 1980s, which is famous for its extensive insights into the environment of early Holocene hunter-gatherers (GRAMSCH 1987; 1990; 1993; 2000; 2009/2010; 2011; 2012; 2016; GRAMSCH et al. 2013).

The mammal bones presented in this paper were excavated between 1979 and 1989 in yearly campaigns under the direction of Bernhard Gramsch (at that time: Museum für Ur- und Frühgeschichte Potsdam). His most important trenches were located in an area of Mesolithic refuse deposits at the base of a sandy hill (GRAMSCH 2000). In these peaty sediments the preservation conditions for all kinds of archaeological remains were very good, and this allowed the excavation of numerous organic finds. All trenches showed the same four different, separated refuse layers, and these layers, called ‘complexes’ by the excavator, are dated palynologically as well as by about one hundred radiocarbon dates (GÖRSDORF/GRAMSCH 2004; GRAMSCH 2016). The oldest find layer (complex I) at the bottom of the sequence dates back to the mid-Preboreal chronozone (9150 to 8850 cal. BC), the subsequent one (complex II) to the late Preboreal (8750 to 8400 cal. BC), and complex III was deposited during the early Boreal (8300 to 7900 cal. BC). Another find layer covers phases of human occupation of the site between the Late Boreal and the Late Atlantic period; it is not part of the present study (for archaeozoological results: BENECKE 2016).

Parallel to the excavations and the subsequent analyses of the finds as well as investigations into the history of the surrounding landscape extensive environmental investigations were conducted, which today allow a detailed reconstruction of the local Preboreal and Boreal development of vegetation and hydrology. Thus, Friesack 4 was once situated on a small island of 6000 to 9000 m<sup>2</sup>, which was part of a large waterscape in an elongated valley surrounded by moraines covered with open birch and pine and later hazel forests (Fig. 1; GRAMSCH 2000; GROSS 2017; JAHNS et al. 2016; KLOSS 1987a; b; THEUERKAUF et al. 2014). From the beginning of research archaeozoological analyses were integrated into the investigations, and first papers presented overviews and interpretations of the excavated remains of dogs, beavers, and birds (TEICHERT 1993a; b; 1994). However, due to re-organisations after the retirement of the responsible archaeozoologist in the midst of the investigations it took twenty more years for the first comprehensive studies about the Mesolithic fish (ROBSON 2016) and mammal (SCHMÖLCKE 2016) remains from Friesack 4 to be published.

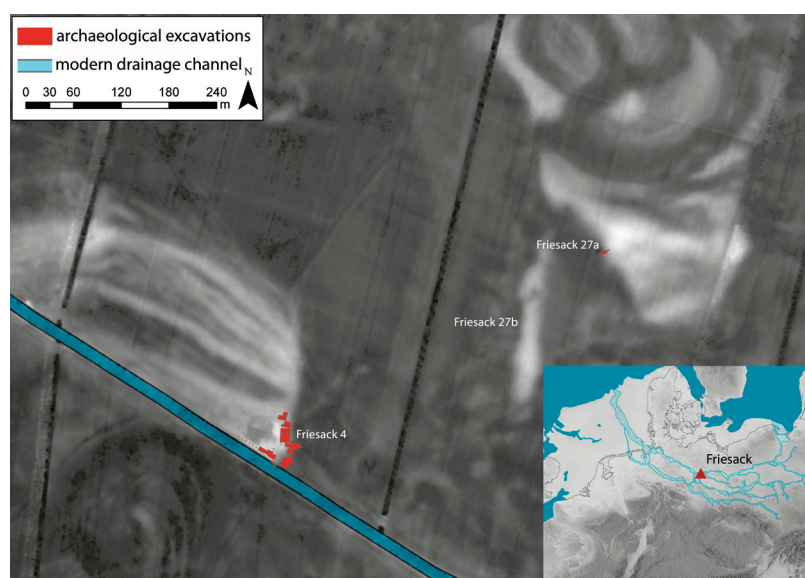
The present paper amplifies analyses and conclusions concerning Early Mesolithic hunting strategies and the seasonal behaviour of the inhabitants of Mesolithic Friesack 4. Potentially the results from this locality can at least in parts be generalised for inhabitants of the Central European lowlands during the first millennia of the Holocene.

## 2 The Mesolithic mammal remains from Friesack 4

The primary archaeozoological analysis of the animal remains was carried out in the laboratories of the Centre of Baltic and Scandinavian Archaeology (ZBSA) in Schleswig, Germany, with its comprehensive comparative collection of animal skeletons. The analyses followed the common way: determination of the finds to skeletal element and species, establishment of the absolute and relative frequencies of the species (specified as Number of Identified Specimen [NISP] and Minimum Number of Individuals [MNI]) as well as their skeletal representation, estimation of the fragmentation of the finds, determination of the bones according to age and sex, measuring, etc.



Fig. 1. Location of Friesack 4 and of the neighbouring contemporaneous sites Friesack 27a und Friesack 27b. Levels of grey illustrate the modern relief (after GROSS 2017, fig. 5; main map created by use of © GeoBasis-DE/LGB [2013], smaller map after GRIMM 2009).



The state of preservation of the animal bones from Friesack 4 varies from good to excellent and shows the fragmentation patterns characteristic for disarticulation and butchering. In total more than 17,000 mammal remains were excavated, and about 40 % of

the remains could be identified to a higher taxonomic level. The NISP is 826 in the Preboreal complex I, exactly 1200 in the early Boreal complex II, and 3082 in the mid-Boreal complex III (for details concerning the archaeozoological analyses and interpretations see SCHMÖLCKE 2016).

In complex I 17 different mammal species are recorded. Roe deer (*Capreolus capreolus*, NISP 242 = 29.3 %) and red deer (*Cervus elaphus*, NISP 221 = 26.8 %) are with quite similar proportions the most frequent species (Fig. 2), followed by beaver (*Castor fiber*, NISP 95 = 11.5 %), wild boar (*Sus scrofa*, NISP 91 = 11.0 %), elk (*Alces alces*, NISP 57 = 6.9 %), and dog (*Canis lupus* f. *familiaris*, NISP 53 = 6.4 %). On the basis of the bone weight red deer dominates, followed by elk. All other species are rarely recorded, and none of them reaches 2 % of the total NISP. Fur-bearing animals represent 13.1 % of the NISP in complex I. Recorded fur species are red fox (*Vulpes vulpes*), wildcat (*Felis silvestris*), otter (*Lutra lutra*), and pine marten (*Martes martes*).

In comparison to complex I the situation in complex II looks a bit different (Fig. 2). The total number of recorded species is again 17, but now roe deer is clearly the most frequent species in the bone assemblage (NISP 424 = 35.3 %). The proportion of red deer remains also increases and now reaches 28.3 % (NISP 340); it is followed by wild boar (NISP 193 = 16.1 %). On the basis of bone weight, red deer, elk, and aurochs (*Bos primigenius*) dominate the mammal remains from complex II. Fur-bearing species now reach 7.0 % of the NISP.

A much larger assemblage of mammal remains was recovered from complex III, and consequently a higher number of species was recorded (22 taxa). Roe deer clearly dominates the assemblage (NISP 1268 = 41.1 %), and again red deer (NISP 716 = 23.2 %) and wild boar (NISP 531 = 17.2 %) follow (Fig. 2). No other species reaches more than 4 % of the NISP. Based on the bone weight wild boar was

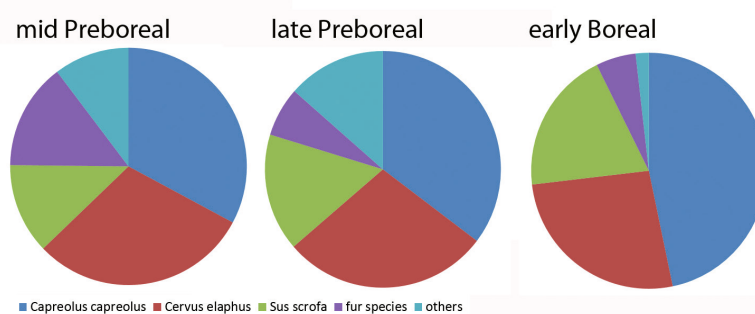


Fig. 2. Friesack 4, Mesolithic layers. Amounts of the three most frequent mammal species. NISP = 826 in the Preboreal complex I, 1200 in the early Boreal complex II, 3082 in the mid-Boreal complex III (for more details see SCHMÖLCKE 2016).

much more important in complex III than in the older occupation stages, but red deer still comprises the major part of the bone weight. Finally, the proportion of fur-bearing animals remains nearly constant at 7.8 % of the NISP.

Evidence for hunting strategies targeted on mammals in the Friesack 4 bone assemblages can be derived from three different aspects: the age structure of the hunted animals, the representation of their skeletal parts, and the seasonality of hunting. For an interpretation, however, it is necessary to bear in mind that there are not only three different Mesolithic layers covering nearly fifteen centuries, but also that each layer is again divided into up to twenty separable occupation events (GRAMSCH 2016).

## 2.1 Age and sex structure

The age at death of hunted mammals can indicate, among other aspects, hunting targeted on animals of special age groups, the hunting effort in general and the ecological sustainability of the hunt. It can also provide information about selective seasonal hunting patterns. The basic requirement is a precise determination of the age at death of individuals in the sample, and for this it is particularly necessary to know the chronology of the mandibular tooth wear stages. For an understanding of the hunting strategy it is helpful to compare the age distribution recorded in a subfossil sample with the natural age structure of a game population at the end of the birthing season. A histogram visualising the natural population's age structure illustrates the number of individuals of different age classes that are alive in a stable natural population at a given point in time, and shows finally the age distribution that would be found in a bone assemblage if the total natural game population had died at once (see STEELE 2005 for problems and advantages of this method). Therefore such a histogram of a natural population's age structure is called a 'catastrophic' profile (KLEIN et al. 1981).

For roe deer in total 67 remains of upper and lower jaws allow the analysis of tooth development and wear. They show quite similar patterns in choice of prey during the three Mesolithic stages of occupation, since in every case animals with an individual age between one and two years are by far the most frequent age-group in each assemblage. These preferences are especially remarkable because in a natural population only a small minority of about 15 % of all animals belongs to this age-group (Fig. 3).

Analyses of several modern roe deer populations show that under natural conditions fawns and other very young animals dominate the stock quantitatively by far. Their mortality, however, is immense and reaches 18 % within the first 35 days of life (ANDERSEN/LINNELL 1998), 39 % up to the age of eight months (GAILLARD et al. 1993), and even 75 % up to the age of one year (KAŁUZIŃSKI 1982). The fact that at Friesack 4 roe deer with an individual age between one and two years dominate shows that the hunters purposefully searched for roe deer of this special age – probably because quality and amount of meat are both excellent at this age, but it can also not be excluded that they practiced a kind of conservation measure by sparing the fawns to grow into better hides and more meat (see ELDER 1965, 369).

On the other hand: fawns with a maximum age of 14 months were undoubtedly an important source of meat for the inhabitants of the site. In complexes I and II each, 38 % of the roe deer jaws derive from very young roe deer (5 of 13 finds, 6 of 16 finds, resp.); in complex III they still represent 29 % (11 of 38 finds). Since roe deer of this age provide less meat and other raw materials than older roe deer in regular, it might be that we see here the result of purposeful decisions of the hunters. Maybe the spotted skins of the fawns were desirable raw material for clothing (ROWLEY-CONWY 1995). It seems to be more likely, however, that fawns were not killed in such numbers because of human preference but because of their frequency within the natural population. If so, it is likely that the hunters' strategy was not to get a maximum of food resources per hunting expedition, but rather to secure a successful hunt. This assumption is supported by the fact that the hunters preferred female roe deer: a size discrimination of the 24 unfragmented astragali from Friesack 4 shows that 92 % (n = 22) derive from females, and in this regard there were no significant

changes between the different Mesolithic occupation periods (SCHMÖLCKE 2016, fig. 13). It has also to be kept in mind that last year's juveniles often form mobile groups, which are more vulnerable and exposed to greater hazards (McDIARMID 1978).

The red deer remains show quite similar patterns in age structures in each of the three complexes. In every case, remains of juveniles or of young adults dominate the assemblage by far: epiphyseal fusion analysis shows that 72 % of the red deer remains derive from specimen of a maximum age of three years (unfused proximal humerus, distal radius, proximal ulna, proximal tibia, calcaneus;  $n = 96$ ). Furthermore, a small majority (53 %, basis  $n = 24$ ) of bone parts with an epiphyseal fusion at 8–10 months were not yet fused, indicating younger individuals. For the teeth the situation is very similar (Fig. 4). In sum these results suggest a preference for juveniles and

adults about three years old. This result is in contrast to many Danish Mesolithic sites, where remains of four to eight year old individuals dominate the bone assemblages (BAY-PETERSEN 1979, fig. 3), but it is more or less congruent with the natural population structure. The mortality of young and juvenile red deer is much less than in other game species, so that about half of all individuals reach at least an age of three years, and about one of three even reach an age of six years (STEELE 2005, 406; WAGENKNECHT 1985, 335). Since red deer become full-grown between six and eight years (WAGENKNECHT 1985, 46–48), the Danish age profiles demonstrate a special human interest in hunting especially prey rich in meat. At Friesack 4, but also at some Mesolithic sites in Scania (MAGNELL 2006, 81), the hunters preferred younger individuals. This could be a consequence of the natural supply, and in this case it would reflect a kind of opportunistic hunting, but it has also been discussed that such preference could be the result of hunting pressure in the surrounding of the settlements (allowing only few individuals to reach a higher age; MAGNELL 2006, 82), and of the social behaviour of the animals (three year old red deer leave their herd and, straying around alone in unfamiliar territories, become easy prey; see SALA 2006). Another Danish Mesolithic site, Ringkloster, occupied during the Atlantic period, shows a completely different scenario at first view with a high proportion of remains from very young fawns, mostly newborns or even foetal animals (ROWLEY-CONWY 1995). But such a result also suggests a focus of the hunters on females in calf or shortly after birth.



Fig. 3. Friesack 4, Mesolithic layers. Age determination of the hunted roe deer based on tooth eruption and erosion data plotted against the mortality curve from natural populations (KAŁUZIŃSKI 1982, tab. 5; ANDERSEN/LINNELL 1998, abstract, for one month; GAILLARD et al. 1993, 788 for eight months).

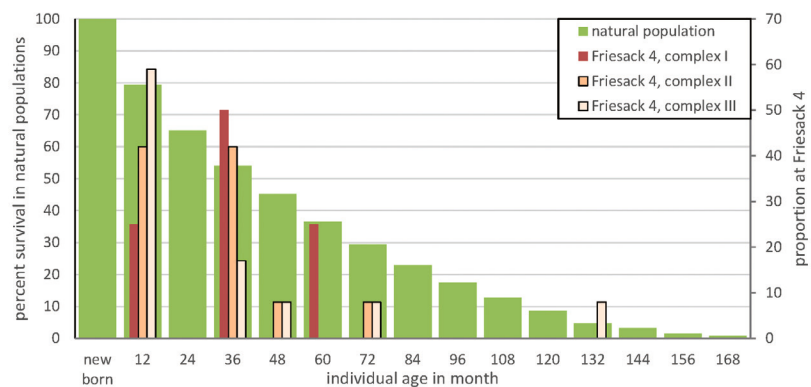


Fig. 4. Friesack 4, Mesolithic layers. Age determination of the hunted red deer based on tooth eruption and erosion data plotted against the mortality curve from natural populations (after WAGENKNECHT 1985, 335 ig. 2/17).



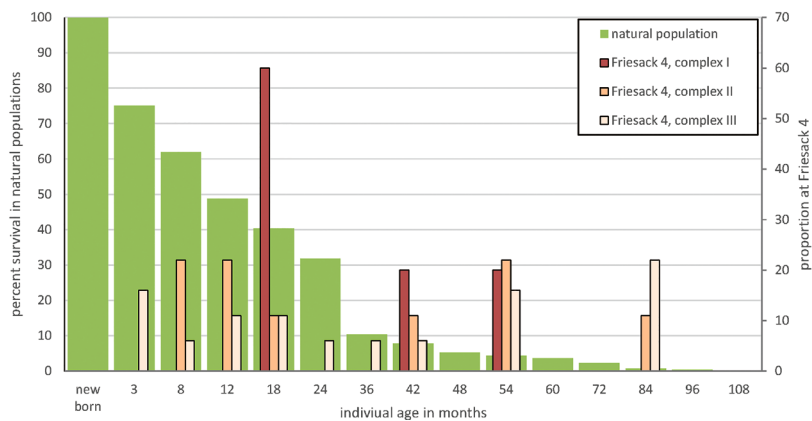


Fig. 5. Friesack 4, Mesolithic layers. Age determination of the hunted wild boar based on tooth eruption and erosion data plotted against the mortality curve from natural populations (after JEZIERSKI 1977).

of the animals reach an age of 36 months (JEZIERSKI 1977). We know Mesolithic sites where the age distribution among recorded wild boars follows exactly the natural pattern within the local population, indicating an absolute unselective hunting (Tågerup; see MAGNELL 2006, 71), but at Friesack 4 such an unselective hunting was definitely not the case in any of the three phases of occupation. In complex I the number of available data is very small ( $n = 5$ ), but it seems that young adults between 12 and 18 months are as overrepresented in comparison to a natural wild boar population as are older animals of four or five years – the latter are full-grown individuals because wild boars reach their maximum body size only with four to five years. Full-grown wild boars represent only a small part of a natural population, but 20 % of the small Friesack 4 complex I assemblage go back to such individuals (Fig. 5). Data bases for complexes II ( $n = 9$ ) and especially III ( $n = 18$ ) are a bit more informative. Both age distributions are very similar and show that generally animals of all ages from piglets to old individuals were hunted. The comparison with the natural population structure documents, however, that in particular full-grown wild boars older than four years were in the hunters' focus. Their proportion in the bone assemblages is several times higher than in an original population, whereas younger animals are underrepresented (Fig. 5). The over-representation of full-grown wild boars in the Friesack 4 assemblages is a clear evidence of a selective hunting of wild boars for meat. There are contemporaneous sites known with an even stronger focus on adult wild boars: at Ageröd I:HC, for instance, nearly 70 % of the wild boar remains derive from animals which were at minimum three years old (MAGNELL 2006, 71), a value seven times higher than in an natural population.

Of particular interest is the sex distribution in the wild boar assemblage of Friesack 4: on the basis of size dimorphism in scapula, humerus, tibia, and talus bones of adults (MAGNELL 2005, fig. 2) the ratio of females to males is 16 to 1, whereas according to morphological differences in the canines there are  $n = 6$  of both sexes. For unknown reasons such contradictory results are also known from other Mesolithic sites; probably the sex distribution based on the osteometry reflects the real situation better (MAGNELL 2005, 35). Since in natural populations the mortality among males is significantly higher than among females during the first four years of life (JEZIERSKI 1977) – which causes a predominance of the latter among adults – the fact that more adult females than males were hunted is also known from other Mesolithic sites (MAGNELL 2005). Nevertheless, the massive predominance of adult females in Friesack 4 can be seen as a preference of the hunters.

The age structure of a natural wild boar population shows comparably moderate mortality rates for piglets: at least about half of all piglets survive their first twelve months, and about two of five wild boars survive at least until their first period of reproduction with about 15 to 18 months (KEULING et al. 2013). However, in contrast to other species the mortality in wild boars remains constantly high over the first three years, with the result that only 10 %

## 2.2 Representation

The representation of remains of the main parts of the animal bodies – head, trunk, meat-rich proximal parts of the limbs, meat-poor distal parts of the limbs – in Mesolithic waste layers can provide different information of archaeological relevance, but in the present case the focus will be on information about hunting areas and use and transport of killed prey.

In Friesack 4, there is a disequilibrium of different skeletal parts in the case of roe deer. In all three Mesolithic assemblages bones from all anatomical regions are present, but elements of the trunk (vertebrae and costae) and of the distal parts of the limbs (radius, ulna, tibia, metapodials) are under-represented compared to parts bearing more meat. Scapula, humerus and femur – all from body parts with well-developed musculature – are as frequent in Friesack 4 as is the head with skull and lower jaw (Fig. 6a). This result, which can be observed with only minor variation in all three find layers, could suggest that not the whole carcass of a killed roe deer, but only selected meat-bearing parts were carried to

Friesack 4. The hunting or kill site was consequently not identical with the excavated location. The most remarkable result, however, is that the valuable meat-rich trunk was carried back to the settlement only sporadically, as can be seen in the very low representation of atlases (Fig. 6a). It cannot be excluded that this part was traditionally reserved for the successful hunters, who consumed it at the kill site.

In red deer the representation of the different parts of the skeleton is even clearer and suggests a changing pattern over time (Fig. 6b). In complex I (NISP 221) the high proportion of humeri (MNI 6), pelvic bones (MNI 5), and femora (MNI 7) as well as the lower representation of bones from the skull (MNI cranium 2, mandibula 3) and from distal parts of the limbs (MNI ulna 2, tibia 3) indicates a

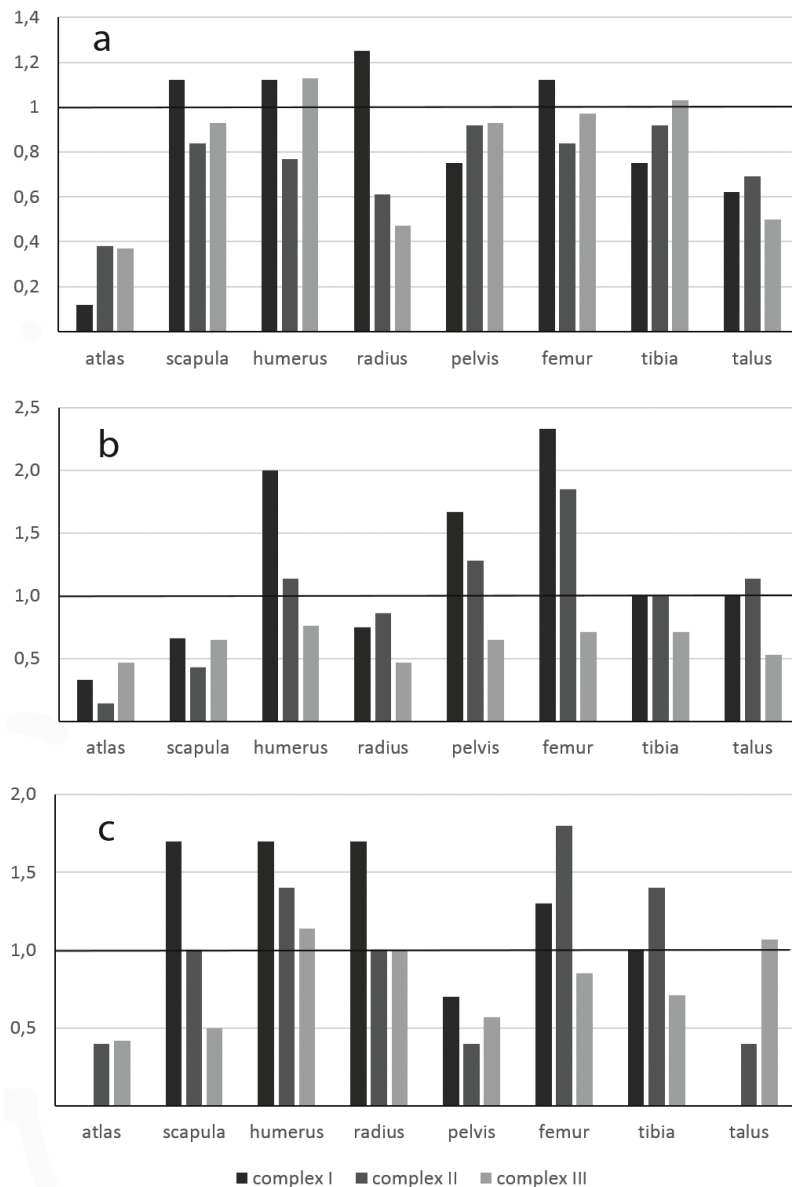


Fig. 6. Friesack 4, Mesolithic layers. Amounts of selected skeletal elements in relation to the mandibula. Basis: MNI. a – roe deer, b – red deer, c – wild boar. Complex I, MNI of mandibula: roe deer 8, red deer 3, wild boar 3. Complex II, MNI of mandibula: roe deer 13, red deer 7, wild boar 5. Complex III, MNI of mandibula: roe deer 30, red deer 17, wild boar 14.

selective transport of meat-rich body parts to the excavated site. Somewhat higher are the numbers of metapodials (MNI 4 and 5); these bones played an important role in tool fabrication (GRAMSCH 2011). Remarkably, similar to results for roe deer, the representation of the scapula (MNI 2) and of the first cervical vertebrae is low (MNI 1 and 2, resp.) – again, this could be seen as an indication that at least parts of the loin of venison were not taken to the site Friesack 4, but eaten (or left?) by the hunters at the kill site. In complex II (NISP 340) the general picture is similar, even if there are some changes towards a more uniform distribution of the bones (MNI cranium 8, mandibula 7, humerus 8, pelvis 9, femur 13, tibia 7, talus 8). Scapula, atlas and axis are still underrepresented (MNI 3, 1, and 2).

During the third occupation period (NISP 716), however, the situation changed completely. The most frequent skeletal element is now the mandibula (MNI 17), and the skeletal elements of the other parts of the body are represented relatively equal, indicating that now the whole red deer carcass is present at the site Friesack 4 (MNI humerus 13, femur and tibia 12, scapula and pelvis 11, cranium, ulna, calcaneus, and talus 9, atlas and radius 8).

For wild boar, reliable information about the representation of elements of head, trunk, limbs, and feet is available only from complexes II and III; the relatively small number of finds in complex I (NISP 91) represent the whole skeleton, but further conclusions should be avoided (Fig. 6c). In complex II (NISP 193) limb bones have the highest MNI, and this is the case both for parts rich in meat (MNI femur 9, humerus 7) and for parts with less meat (MNI ulna 8, tibia 7). It is particularly noticeable that some parts of the body especially rich in meat, indicated by the first cervical vertebrae (MNI atlas 2, axis 1) and the pelvic bones (MNI 2), are clearly underrepresented. In complex III (NISP 531) the distribution of the excavated skeletal elements follows on the whole the anatomical norm, with relatively similar MNIs in skull (MNI 13), mandibula (MNI 14), humerus (MNI 16), radius (MNI 14), ulna (MNI 14), femur (MNI 12), and talus (MNI 15). The high number of tali demonstrates that also the most distal parts of the limbs were carried to Friesack 4. In contrast to this result stands the striking underrepresentation of the first vertebrae (MNI atlas 6, axis 5), the shoulder blade (MNI 7) and the pelvis (MNI 8) – all of them bones with much valuable meat around.

At the end it should be mentioned that the body part representation of the game species underlines the good preservation conditions for animal remains in Friesack 4, since less dense skeletal elements are more fragile than more dense ones – bones such as sacrum and vertebrae, but also humerus and femur –, and are easily underrepresented just due to taphonomic processes (LYMAN 1993). It is likely that taphonomy is the reason for the representation patterns observed at some Danish Ertebølle sites with dense bones such as mandible, talus, calcaneus or metacarpus as the most frequent elements – and not human selection or transport (GRON 2015). Whereas for the Danish Ertebølle sites in question it is hard to estimate the extent to which the different game species were part of logistic exploitation strategies, the conclusions for Friesack 4 seem to be reliable.

### 3 Seasonal hunting patterns

Similar to analyses of the life ages of the hunted animals, a precise determination of the age at death is a basic requirement for investigations about seasonal human hunting behaviour. Knowledge about the reproduction cycles of the actual species is necessary for that, in particular about times of birth. However, in particular in the case of wild species it is in practice often difficult to get reliable data. Ecological research has shown that dates of birth vary naturally within a population, but also in individuals, and furthermore these are also influenced by a number of external factors such as weather conditions and climate zone (for details concerning the game species of Friesack 4 see SCHMÖLCKE 2016). Besides, it is a permanent question to which degree the reproduction behaviour of modern animals is similar to that

of their ancestors living under different climatic and eco-geographic conditions (for general limits of interpreting seasonality of faunal remains see MILNER 1999).

In the case of roe deer the problem mentioned is not so difficult, since in large parts of Europe – independently from climate or landscape – May is today the main month of birth (NASIMOVIC 1966, 270f.). For Friesack 4 (Table 1–3), the small number of lower jaws from complex I (MNI 6) might suggest a human presence for roe deer hunting between February and August, while in complex II only animals killed during spring and summer, particularly between May and August (MNI 9), are recorded. In complex III roe deer hunting between December and February is not observable, too, but for the other parts of the year there is no clear seasonality visible (MNI 13). This result is similar to the contemporaneous Star Carr site where also the summer roe deer kill (of yearlings as in Friesack 4!) dominated (LEGGE/ROWLEY-CONWY 1988).

Today about 65 % of wild boars are dropped in March and April, further 25 % in May, and 10 % in other months, but in Sweden for instance February is also relevant with an amount of 20 % of births (for references and details: MAGNELL 2006, 76ff.). In consequence it is problematic to determine a baseline for the wild boars killed by Mesolithic hunters at Friesack 4. The month of April is taken as the basis for the following interpretations, since this month is the main period of birth in Karelia – under similar climatic conditions as in the early Holocene in Central Europe (DANILOV/PANCHENKO 2012, 49). With this starting point in particular there is a clear seasonal reference in the youngest complex III with all recorded mandibulae deriving from wild boars killed between April and June (MNI 10). Such a late spring/early summer hunt is also mirrored by two humeri and a tibia of very young boars (MNI 3). In the other layers the results are not so distinct, but again very young individuals, killed probably in May or June, are recorded. The small number of relevant bones, however, makes conclusions about a seasonality of wild boar hunting difficult for these two complexes, but likely the time of wild boar hunting was early summer for complex I (MNI 3) and between April and November for complex II (MNI 5).

Concerning red deer there is only one evaluable mandibula from complex I, additionally there are at least five from complex II. Given June as the month of fawning the tooth wear stages of red deer show hunting and site occupation from July to October. In complex III the data set is slightly larger (n = 8), and two occupation phases from September to November and during June and July can be verified.

## 4 Conclusions

In all three periods of occupation mainly remains of red deer, roe deer, and wild boar were deposited. The combination of weight and number of finds shows that red deer was the most important species economically, even if the most individuals killed by the hunters were roe deer. The fact that body parts of the prey which are rich in meat are represented in the waste layers of Friesack 4 in an over-proportional extent shows that Friesack 4 was a site of consumption not of killing. This could be demonstrated in the case of the three economically most important species, but it is also confirmed by brown bear remains (NISP 15, MNI 5; only the pelvic region [ham] and metapodials plus phalanges [fur] are recorded), and horse bones (NISP 20; MNI 4; nearly exclusively remains of the distal parts of limbs = eligible raw material for tools?). Only in the case of beaver the whole carcass was brought to the site, since in this species all parts of the skeleton are represented in natural portions. This is not only because beavers were hunted in the waterscape surrounding the settlement, but because not only the fur but also the meat was of value (SCHMÖLCKE et al. 2017, 909–911).

During the whole Mesolithic there was a purposeful hunting of young female deer, and in the case of roe deer their juveniles. These results point to an elaborate hunting strategy, in which the focus was not on large but on dependable prey. Adult roe deer, for instance, are generally very sedentary and stay in areas with

good overview about the environment and a dry and warm local climate (KURT 2002, 43; STUBBE 2008, 147). This is in particular true for the females during and after the fawning season – the main season of roe deer hunting at Friesack 4. Consequently, for well-versed hunters familiar with the behaviour of the roe deer, does are relatively easy to detect and to kill. The increasing proportion of roe deer remains in the three subsequent Early Mesolithic phases renders it likely that the local roe deer population could sustain itself substantially under the continuous hunting pressure. Did the humans flexibly adapt their hunting strategy to the capacity of the game population?

In the case of red deer, the focus of the hunters was not on particularly large animals but on young adult individuals, maybe still more innocuous and inexperienced than older deer. A quite similar picture is given by the analysis of the wild boar remains: the hunting focused on adult animals, but again females and not the larger males were the preferred objects of hunting.

The preference of adult females can easily be the result of special knowledge of the Mesolithic hunters and finds similarities at other Mesolithic sites (LEGGE/ROWLEY-CONWY 1988; ROWLEY-CONWY 1995). Whereas male wild boars leave their family groups with up to twenty animals at the age of about twelve months and start a solitary life – except for the breeding season from November to January –, females remain in their original group or establish a new group nearby. For hunters it is therefore much more promising to lure or stalk females. In view of sexual dimorphism in size with males being significantly larger than females it can easily be a consequence of this hunting strategy that the body size of the hunted wild boars from Friesack 4 was relatively small in comparison to Danish Mesolithic sites in particular (ALBARELLA et al. 2009). However, also differences in regional climate or diet are discussed in this context.

Potentially, in Mesolithic societies hunting strategies differed in relation to the length of site occupation. If the occupation lasted for only a few months per year only, hunting focussed on relatively easy targets (many spring-born juveniles in summer, many inexperienced young adults in winter). In contrast, to maintain sedentary settlements occupied for most of the year, it came to an intensification of hunting in the surroundings, which includes on the one hand side the killing of more dangerous specimens, but on the other hand side also a continued killing of juveniles of all available game species. It cannot be excluded that an increasing hunting pressure on juveniles resulted in an increase of juveniles in the live populations, i.e. the hunted species started to reproduce at higher rates (GROSS et al. accepted; ELDER 1965). Therefore, by well-dosed hunting of juveniles the Mesolithic people were able to significantly increase the game population in the surrounding of their site (ROWLEY-CONWY 2001).

Such reactions to human behaviour are known from intensively hunted North American beaver (DODS 2002) and elks (GRENIER 1979). From that perspective, the observed increasing proportions of juveniles and young adults in the subsequent time horizons at Friesack 4, both in roe deer and wild boar, can be understood as reactions of the animals to an overhunting by the local humans (cf. SCHIBLER/STAPPAN 1999 for Swiss Neolithic red deer populations).

Several Scandinavian Late Mesolithic sites that were occupied for most or all of the year potentially effected a comparable development (ROWLEY-CONWY et al. 2012), but it must be emphasised that small forager groups had surely no general direct influence on regional or even supra-regional game populations. In the case of Friesack 4, additional to and independent from human activities, the increasing population density of roe deer was to a great extent due to the early Holocene climate warming; since midwinter temperatures have a strong effect on roe deer populations (PUTMAN et al. 1996), the rising winter temperature will also have caused a slowly increasing reproduction success.

As investigations of the minimum period of occupation (cf. ROWLEY-CONWY 1995) show, Friesack 4 was probably a summer camp, regularly occupied during the months May to October (Tables 1–3). For hunting people used primarily the dryer hinterland nearby (wild boar, deer species) as well as the direct periphery of the site (beaver). There is some evidence for longer occasional hunting expeditions (hunters

came back with selected parts of brown bear and wild horse). Probably the people left the swampy valley during winter when the water froze and built special winter camps inside the forests on the neighbouring moraines. Inside the forests they were better protected against the cold winter weather, and by the erection of wooden enclosures also protected from carnivores, and – most notably – they were surrounded by firewood.

### **Acknowledgements**

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Table 1. Friesack 4, complex I, seasonal indicators. Each line shows the season related to a single *mandibula* tooth wear stage in the assemblage. The frame comprises the signal of every single bone, with the exception of the topmost.

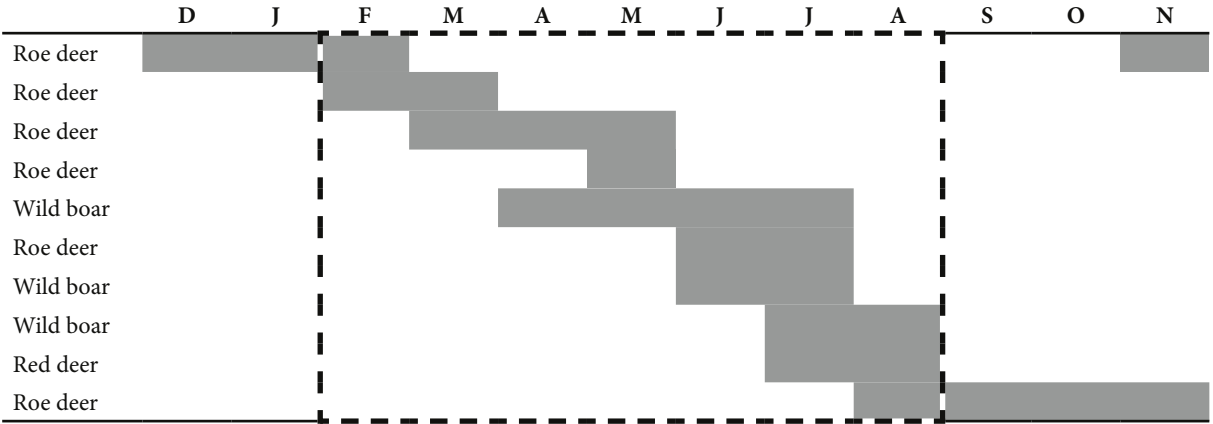


Table 2. Friesack 4, complex II, seasonal indicators. Each line shows the season related to a single *mandibula* tooth wear stage in the assemblage. The frame comprises the signal of every single bone.

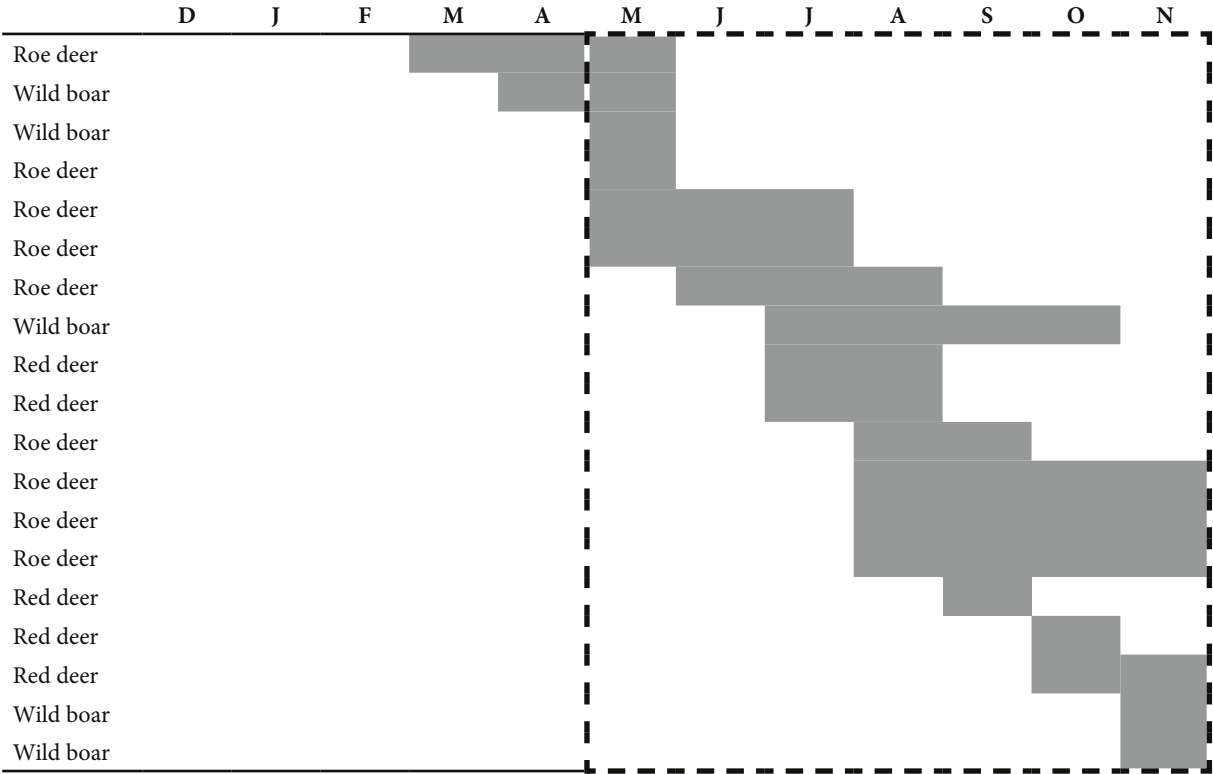
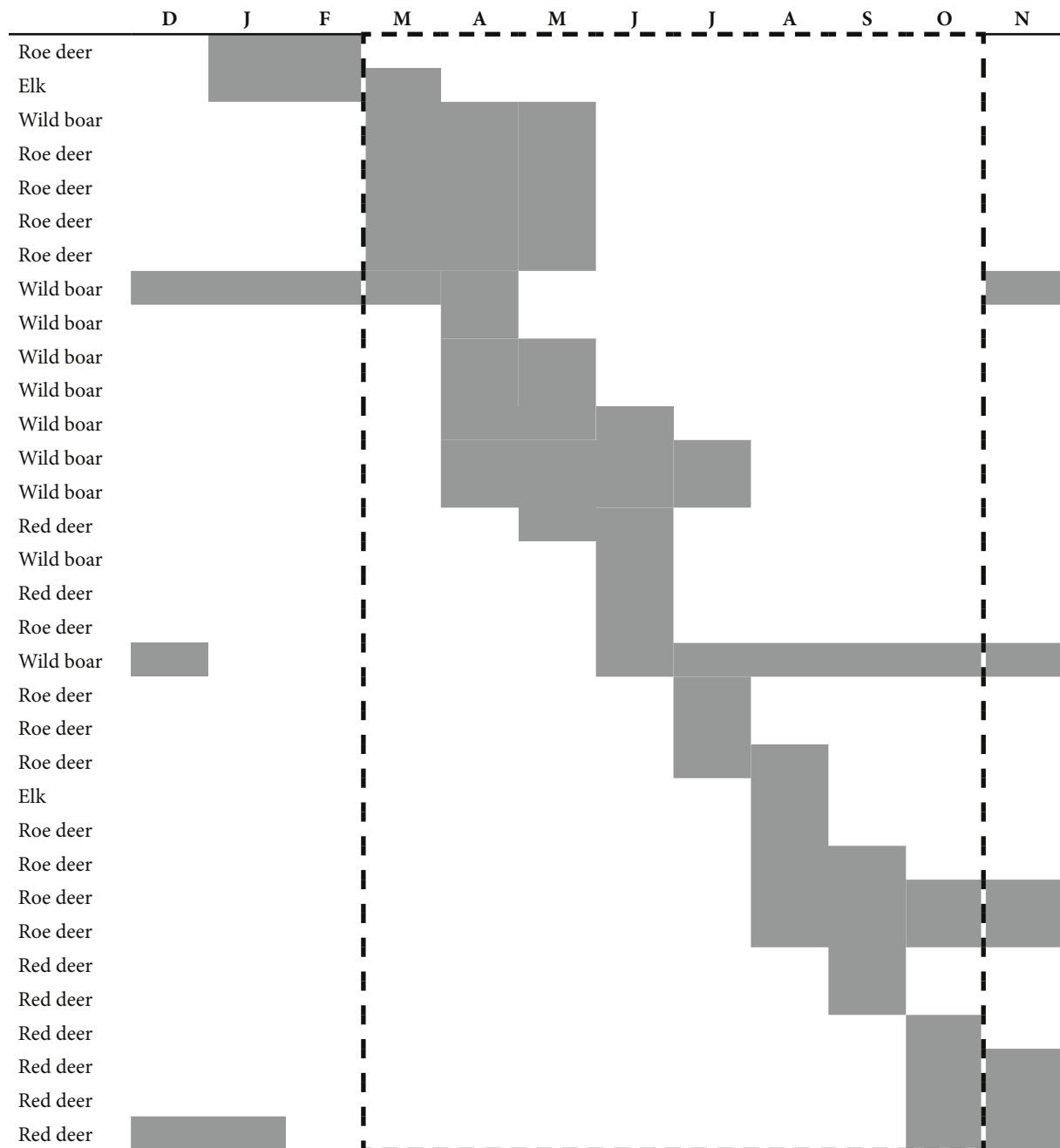


Table 3. Friesack 4, complex III, seasonal indicators. Each line shows the season related to a single *mandibula* tooth wear stage in the assemblage. The frame comprises the signal of every single bone.





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