The Earliest occupation of Central Eastern Europe: Identifying causes for the late colonization of Central Eastern Europe in comparison with Northwestern Europe

Oolders, Jasper

The Earliest occupation of Central Eastern Europe

Identifying causes for the late colonization of Central Eastern Europe in comparison with Northwestern Europe

Jasper Oolders

Front page image: The Mauer mandible. The oldest *Homo* fossil in Germany. Photography by Schacherl, K. In: (Wagner et al., 2010, p. 19727).

Title: The Earliest occupation of Central Eastern Europe

Subtitle: Identifying causes for the late colonization of Central Eastern Europe in comparison with Northwestern Europe

MA Thesis

Name Jasper Oolders

Student Number: s2018489

Course: Master Thesis Global Archaeology

Course Code: 1084VTGY

Name Supervisor: Dr. A. Verpoorte

Leiden University, Faculty of Archaeology

Leiden, 15-06-2023, Final Version

Acknowledgements

I Want to thank Dr. Verpoorte for all his effort and feedback throughout the long process of writing this Thesis and Nouschka for her help in finalizing this work.

Table of contents

List of figures

Tables

Chapter 1 - Introduction

The archaeology of Europe is tightly interwoven with the arrival of various hominids and the wide array of different environments that determined their way of living. The early colonization of Northwest and Central Europe has been heavily debated for a long time. The focus of these debates has mainly centred around the spread of hominids northwards from the areas around the Mediterranean. This colonization of Northwest and Central Europe has always been strongly linked with the climate and the ability of hominids to cope with the much harsher climate found in these areas (Roebroeks et al., 1992, p. 552). When research in this field really started taking off, Roebroeks & Kolfschoten (1994) set a baseline for all future research as they concluded that there was no adequate evidence for occupation that can be defined as settlement in the whole of Europe before 500 kya (thousand years ago). The imposed line is set on the basis of archaeological finds or the lack there of. There are finds that are ascribed to dates older than 500 kya in Europe but the dating of these finds is debatable in various ways. In the article numerous sites are investigated, however none of the sites can produce evidence that would proof they date to pre 500 kya beyond any reasonable doubt (Roebroeks & Kolfschoten, 1994, p. 496). In general, it can be said that the finds supposedly predating 500 kya have no primary context making them relatively useless for archaeologists or they are isolated occurrences near natural deposits. This means that these finds cannot be seen as an archaeological site predating 500 kya. For this reason, the baseline is set at 500 kya for the occupation of Europe, however this does not mean that is written in stone and Roebroeks & Kolfschoten (1994) recognize the fact that it is generally easy to falsify their statement as it would require only one proper site in Europe dating pre 500 kya (Roebroeks & Kolfschoten, 1994, p. 500).

Only six years later and this baseline had been crossed already. Evidence from Atapeurca-TD6, see figure 1.1, is the instigator for a revision of Roebroeks' original hypothesis. A combination of human remains, lithic assemblages and faunal assemblages yielded a dating of over 780 kya (Carbonell et al., 1995, p. 826). These dates were acquired through the means of a palaeomagnetic investigation focussing on an absolute dating of sedimental layers (Parés & Pérez-González, 1995, p. 830). On top of the sediment layer dating, there has also been confirmation for the age of Atapeurca-TD6 through the dating of ungulate teeth found in the same layer as hominin remains.

To acquire a correct dating two absolute dating methods were used namely U-Series and Electron spin resonance dating (Falguères et al., 1995, p. 344). Falguères et al. (1995) mentions these methods were choses as other methods such as Argon-Argon dating were not possible due to the lack of volcanic material. Besides limitations on which dating methods were possible electron spin resonance is generally very successful in dating tooth enamel, as it can work with decomposing material. Decomposition is needed for tooth enamel to acquire datable energy as it works similarly to TL dating with the big difference that it can be used on material that is only heated during its decomposing stage (Renfrew & Bahn, 2016, p. 163).

Roebroeks (2001) recognizes these dates and suggests that it is thus even more likely now that more evidence will turn up proving even more so that Europe was indeed occupied much earlier than 500 kya, however Roebroeks remains doubtful. While Carbonell et al. (1995) suggests that their strong evidence warrant a reinterpretation of other sites which share similar characteristics with the potential of being older then 500kya such as the Italian site Monte Poggiolo, and the finding of the Ceprano skull. This line of thinking is problematic according to Roebroeks as lithic assemblages with simple and minimalistic potential tools are notoriously difficult to date and thus without hominin remains it is challenging to ascribes lithics as tools and thus prove hominin occupation of a site, furthermore, finds such as the Ceprano skull lack the needed context for a critical assessment and accurate dating (Roebroeks, 2001, p. 442). The value of absolute dating methods can clearly be seen through the finds in Atapeurca-TD6, especially when compared with relative dating methods in situations where standalone sites with lacking context and no available sites for comparison require a date.

By this line of reasoning the Atapeurca-TD6 site should for now be seen as an incidental occurrence, however it still proves there was at least some sort of hominin occupation of Europe before 500 kya and this means it is likely more sites in South Europe around the Mediterranean will be found (Roebroeks, 2001, p. 441-442). The sites in the Mediterranean falsified the idea of a short chronology for the whole of Europe, but the idea of a short chronology still holds for Europe above the Alps and the Pyrenees as there are still no sites found older than 500 kya in that region. As Balter (2001) confirms this does indeed sound like the most realistic scenario at that moment and is therefore widely accepted.

Yet in 2005 a huge uproar in the short chronology of non-Mediterranean European occupation is caused by lithic artifacts found at the English site Pakefield. Pakefield is a coastal village located in the county of Suffolk. In total 32 worked flint pieces, one core and retouched flake and 30 waste pieces, dating back to around 700 kya were found all within the same interglacial infill of a channel carved into Early Pleistocene marine sediments (Parfitt et al., 2005, p. 1008). Dates for the finds were acquired through an amino acid analysis specifically designed for obtaining geological dating, perfect for dating the sediments in which the lithics were found (Parfitt et al. 2005, p. 1011). These sediments are part of the Cromer Forest-Bed Formation which stretches along the English Eastern North Sea coast. This formation is a fossil rich area with plenty of other faunal fossil remains. At the time when the lithics found in Pakefield would have been used Europe looked quite different, however the Pakefield site was already a coastal site 700 kya (Parfitt et al., 2005, p. 1009). Interestingly 700 kya the climate of the site was drastically different then what it is nowadays as it is described to be very temperate with overall warmer summer and winters with seasonal rainfall resulting in Parfitt et al. 2005 describing it as a Mediterranean climate. These findings are based on faunal and flora proxies found at the site in combination with the isotopic composition of the site (Parfitt et al., 2005, p. 1010).

The correlation with the Mediterranean in terms of climate is interesting. As Roebroeks (2001) mentions already it is likely that more sites will be found in the Mediterranean area and while this is in no way a Mediterranean site it does seem to bare some resemblances as Parfitt et al. (2005) does describe the climate of Pakefield to be a Mediterranean climate. The Pakefield finds opens up possibilities for more sites to be found above the Alps and Pyrenees Mountain ranges as apparently climate might not have been the limiting factor it was considered to be or in other words the beneficial climate of the Mediterranean could be found at more places than previously thought and thus those areas were also suitable for hominin occupation (Roebroeks, 2006, p. 428). Drawing from the correlation of climate and hominin occupation it is concluded by Roebroeks (2006) that there might well be a relation between the late occupation and the cold climate areas of North and Eastern Europe. It is however not as clear cut as other reasons are also brought forward as Parfitt and Roebroeks do realise that the long wait for finds from the Pakefield area can also partly be described to a lack of interest due to the area having a low fossil find expectation (Roebroeks, 2006, p. 428).

Figure 1.1 Map of Europe with sites indicated mentioned in this chapter. 1 Atapeurca-TD6, 2 Monte Poggiolo, 3 Pakefield, 4 Pont-de-Lavaud, 5 Happisburgh 3, 6 Bois de Riquet. Original map from Wikipedia edited by author (www.commons.wikipedia.org).

It is from this moment onwards that Europe truly can be divided into smaller areas with strong differences when it concerns the first occupation dates of Europe, namely that the western parts of Europe were occupied significantly earlier. Naturally the dates mentioned above will be altered by the discovery of new sites but what has become clear from the above-mentioned sites and the sites that will be mentioned in the next body of text is the division between western Europe and the Eastern parts of the core area of Europe. This has been mentioned and suggested by for example (Roebroeks, 2006, p. 429) and now with the find in Pakefield there is a strong foundation for such a claim. The upcoming sites will only confirm this apparent division.

Shortly after the discoveries at Pakefield, evidence from the centre of France from the site Pont-de-Lavaud further illustrates that hominin penetrated more parts of Europe and were not just present in the Mediterranean below the Pyrenees and Alp Mountain chains. While Pakefield is dated to at least 780 kya the artifacts found at Pont-de-Lavaud have been dated between 1.2 mya and 1 mya (Despriée et al., 2006, p. 823). This is once again a huge gap and while it is difficult to say how permanent such an occupation might have been it does however reaffirm the notion that natural borders were not the major constraints for hominins expanding into Europe as was suggested before the Pakefield finds. Yet the site of Pont-de-Lavaud is at its discovery the oldest site above the 45th northern latitude in Western Europe (Despriée, 2006, p. 828). The finds at Pont-de-Lavaud consist of roughly 5000 quartz artifacts however tools are rare. To obtain a dating for these tools Electron spin resonance has been used on bleached quartz pieces obtained from fluvial sediments which is well tested and suitable method if the artifacts are found in the right circumstances (Moreno et al., 2017, p. 162). Despriée et al. (2006) did various dating from different sources on the site which all generated the same timeframe of 1.2 mya – 1 mya making the results very reliable.

More evidence for early occupation of Western Europe is found at the British east coast on the Happisburgh 3 site in Norfolk, the neighbouring county of Suffolk, where the Pakefield finds were uncovered five years earlier. At Happisburgh 3 a total of 78 flint artefacts have been found. The artifacts are dated to at least 780 kya and consist of a mix of cores, flakes and flake tools. Found in various overlapping channels filled with fluvial gravels and estuarine sands the lithics do however not show evidence of long-term fluvial transport (Parfitt et al., 2010, p. 229). To establish a dating for the site both relative and absolute dating methods were used. Both methods are useful here as they help in providing a relative narrow timeframe since exact dates are not necessary and incredibly hard to obtain when discussing a research area that encompasses such a large part of history. At Happisburgh 3 45 laminated silt samples from various beds were used for palaeomagnetic analyses. The results from the palaeomagnetic analysis showed a rather large absolute window for when the analysed sediments were deposited which in turn stands for the moment when the lithic artifacts had been deposited. The yielded results indicated somewhere between 2.52 mya and 780 kya. To narrow this down the use of a relative dating method was used. Biostratagraphic evidence from a combination of fauna and flora mixed with the absolute border of 780 kya revealed that the site had

been occupied somewhere between 990 kya and 780 kya (Parfitt et al., 2010, p. 231). While the climate at the site was much softer than it is today Parfitt et. al., 2010 do describe it as a combination of a northern forest which must have brought its own challenges for these hominins while also being part of a resource rich fluvial environment including rivers, floodplains and marshes while all being in reach of the coast which likely negated some of the struggles of the harsher climate that might be expected here or in similar locations elsewhere (Parfitt et al., 2010, p. 232). Happisburgh has provided us with more evidence of early occupation as in early 2013 hominin footprints were discovered at the site. The footprints are dated between 1 mya and 780 kya which is almost identical with the lithic artifact dating from three years earlier (Ashton et al., 2014, p.1). While in that sense they do not necessarily push back the date of the first occupation, as 10.000 years is hardly anything on the timeframe we are working with, they do provide a lot more information on who those hominins were. Based on comparisons for foot size, foot area and stature the footprints found at Happisbrugh would best correlate with those of *Homo antecessor* (Ashton et al., 2014, p.11).

Between 2008 and 2012 archaeological excavations took place at the site Bois-de-Riquet, located in southern France near the Mediterranean coast, which resulted in the discovery of 23 basalt artifacts and 2875 fossil remains. The site is characterized by thick deposits of basalt flowstone (Bourguignon et al., 2015, p. 26). This provides an opportunity for the use of 39ar/40ar dating as the basalt infill stems from volcanic material. Argon-Argon dating is a very suitable and often used method to date old hominin sites as the window in which argon-argon dating can be used is between 5 mya and 100 kya. The big drawback for European sites is that it does require volcanic rock which is simply not present in most parts of Europe (Renfrew & Bahn, 2016, p. 155). However, as basalt is a volcanic rock it could be used at Bois-de-Riquet. The basalt flowstone was thus dated at 1.57 mya. This date does however not necessarily resemble the moment hominins occupied the site but rather when the basalt was deposited and cooled down. So, Bourguignon et al. (2016) used mammal fossils found in the sediments of the site to create a biochronological interpretation and so the site and the basalt artifacts have been dated between 1.3-1.1 mya (Bourguignon et al., 2016, p. 24).

As the site consisted of a basalt infill while the artifacts were also made from basalt it proved difficult to identify the artifacts as proper lithic tools used and made by hominins and not just a natural breakage from the original basalt deposit. To overcome this problem Bourguignon et al. (2016) went to great lengths to establish a model against which potential finds could be tested. The model consisted of a comparison with other sites known to have similar Oldowan type basalt lithics and then using those methods to create and replicate basalt tools by means of experimental archaeology so that unique characteristics of hominin basalt tool production could be identified and then be compared for similarities with the potential basalt tools from Bois-de-Riquet (Bourguignon et al., 2015, p. 34). This thus resulted in the determination that 23 pieces of basalt were lithic tools of which 10 were unmodified and 13 were modified pieces of which twelve are classified as flakes and one as a core (Bourguignon et al., 2016, p. 35). Bois-de-Riquet fits within the picture of continuously finding older sites in general and by finding them further up north than previously discovered sites.

This narrative has naturally continued. As me move further up north there are plenty of other archaeological sites that have been discovered and have proven to be much older than the original baseline of 500 kya set all the way back in 1994 by Roebroeks and Kolfschoten. Their hypothesis has thus been proven wrong in the exact manner they anticipated, simply by finding sites older than 500 kya. The point of this chapter was to illustrate how in almost 30 years our view on the earliest occupation of Europe has changed. Certain sites have naturally been left out of this overview as they did not fit within the limitations of this research. Think for example of sites such as Dmansi which is very important and famous but cannot be seen as part of the core areas of Europe in which the other sites previously mentioned have been placed in. While an artificial selection was necessary the general trend that should be concluded from this research history overview is as follows: Southern Europe was visited the earliest by hominins arriving in Europe after which they spread towards younger sites at more northern locations in Europe (Macdonald et al., 2012, p.91-92).

1.1 - Research question

Various dating methods have previously been discussed and more are to follow. In order to prevent any discrepancies between dates and correlation with other time scales such

as Marine Isotope stages in this research the dates and time period indication will always follow the 'Global chronostratigraphical correlation table for the last 2.7 million years' version 2022a by Cohen and Gibbard (2019).

As we look at the earliest sites in the core areas Europe there is a striking division between sites. The earliest sites in the Mediterranean region of Europe go back to 1.3 mya (Bourguignon et al., 2016, p. 24; García & Arsuaga, 2010, p. 1413) and in the area often designated Northwestern Europe the dates go back to at least 780 kya (Parfitt et al*.,* 2010, p. 232). Here Northwestern Europe is seen as the area encompassing everything between middle France, Great Britain and everything west of the Rhine in Germany. A big division noticeable in the archaeological record is between Northwestern Europe and Central Eastern Europe which encompasses the area east of the rhine till the eastern edge of Poland and the Alps as southern border. If we are to compare these two regions with each other based on the earliest occupation it becomes clear that there is a vast difference as the earliest sites in Central Eastern Europe only appear around the 500 kya mark (Cohen et al., 2012, p. 80; Hopkinson, 2007, p. 297). This means there is at least a 200.000 year gap between the earliest occupation between these areas! This discrepancy is remarkable and it becomes even more extreme when kept in mind that while there are sites after 500 kya in the Central Eastern Europe region they remain extremely rare and only increase in quantity roughly after 400-300 kya, while at the same time the archaeological record of the area of Northwestern Europe is described as rich in sites from MIS 16 onwards (Ashton & Davis, 2021, p. 1; Hosfield, 2020, p. 61; Rocca, 2016, p. 214-215). This difference in occupation dates is the main focus of this thesis.

The main question that corresponds with this is as follows: Can it be concluded, based on the evidence from sites in Central Eastern Europe, that there is a gap between the first occupation in Northwestern Europe and Central Eastern Europe and if so what are the causes for this gap?

To reach a position in which an adequate answer can be given it will first be necessary to get a good grip on what the situation was in these two regions at the times of the first occupation. An overview of the sites in Northwestern Europe has been made as seen in the introduction. Following that up in the next chapter an extensive dive into the oldest

sites of Central Eastern Europe will be made. Here the focus will first lie on the dates of the sites and how these dates were established. An examination of the various dating methods and their suitability will help in determining if there is indeed a gap between the earliest occupation date between Northwestern Europe and Central Eastern Europe. This will allow us to give an answer to the first part of the research question. Assuming there is indeed a gap between the first occupation in these two regions the second part will be an analysis and discussion on why this gap exist. As we do not know where the answer might be found comparing sites within Central Eastern Europe with each other will be helpful so we can identify certain patterns that might arise and rule out incidental occurrences. As the areas that are being discussed and compared are quite large, we cannot base evidence solely on a single site. With the help of these sites, we can then zoom out and make a comparison on the larger regional scale between Northwestern Europe and Central Eastern Europe in order to find further answers that might explain the difference between the regions. All of the data needed will be gathered through the means of an extensive literature study. The data will be selected through and categorized in four chosen categories. These have been chosen as they seem to be the most promising in unearthing meaningful differences between the regions while still encompassing the possible differences in the most complete way. Below are the four categories which can be seen as four smaller hypotheses aiding us in answering the second part of the research question.

1. Climate

The hominids that moved into the more northern parts of Europe faced a variety of challenges. These challenges are almost all centred around the harsh climate that northern Europe has, especially when compared with the climate of the Mediterranean areas. The focus of these problems lies in the harsh winters which is when these new dangers would present themselves. The core of these new challenges can be summarized as followed: Lower temperatures with an increased variation between day and night, a reduction in daylight hours, a scarcer availability of both animal and plant foods and dangers and or hinderance brought by heavy participation in the forms of both rain and snow (Hosfield, 2016, p. 654). An example of scarcity that might be expected is the lack of vitamin C in northern climates. While vitamin C is often acquired through plant-based food in certain regions there might be a lack of these plant staples

and therefor certain climates require different resources and survival tactics with different methods to get sufficient vitamin C making it all together more inhospitable than other liveable areas which can possibly explain a later occupation date (Speth, 2019, p. 174).

Besides the harshness of a climate the amount of variation between seasons, called seasonality, can also play a strong role in the ability of hominins to survive in these climates. Overall, it is assumed that the stronger the seasonality the harder it is to survive (Cohen et. al., 2012, p.78). On the premises of such limitations, we can think about expansion ranges. Using environmental proxies of various sites and comparing them with each other by placing them in a west versus east comparison helps with identifying possible variations between the region that could explain a potential difference in why there would be a gap between earliest occupation dates. It is however important to make a distinction between time periods as the climate in both regions is not constant. To explore variations, it is useful to look at the difference in climate between the regions in various Marine Isotope Stages to create a good general image with which we can make a larger Interregional comparison (Ashton, 2015, p.139).

2. Glaciation

The climate in Europe is heavily influenced by glaciation which in turn strongly influences the climate and could create extremely harsh circumstances at glacial maxima (Ashton, 2015, p. 138). The opposite also happens. In interglacial maxima the influence of the ocean on the climate could be very strong meaning that the oceans influence could even reach far into Central Europe creating an exceptionally soft and warm climate (Cohen et. al., 2012, p. 71). The accumulation of land ice is another important characteristic of glaciation periods. During the Elsterian glaciation the Fennoscandian land ice sheets reached its maximum expansion range. Large parts of the Central Eastern research area were then covered by this land ice. Influential periods like this are key parts in the debate around the first colonization of these previously ice-covered areas. One effect of the Elsterian glaciation and the subsequent land ice expansion is the transportation of Baltic flint into Central Eastern Europe which could possibly have been a pull factor for the region (Lauer & Weiss, 2018, p. 2). Lastly, another effect of the expanding land ice is that it is likely to affect site preservation in a negative way. While it might be possible to identify diagenesis phenomena in the taphonomy of finds caused

by glaciation on certain sites it might well be the case that the glaciation has destroyed any evidence of occupation in the land ice covered area before the Elsterian glaciation period began. Naturally this is difficult to prove but is still an important possibility that must be kept in the back of our mind (Lauer & Weiss, 2018, p. 2).

3. Resources

A climate dictates conditions in which certain strategies have to be enacted and actions have to be taken in order to survive. Resources are thus essential to any hominin since they allow those hominins to enact and take those strategies and actions. These can be seen as food sources but also materials needed to create tools. Simply put a resource is anything that might help a hominin survive in a certain climate. While certain resources might be globally present and readily exploited by hominin, their importance and value in a certain area is strongly linked with the climate but also the landscape and geography. Resources help hominins in overcoming these challenges. Naturally, a coastal humid area boasts different resources then a dry continental coniferous forest, think of the different animals and plants that live in those areas but also in the difference in material commodities. It is thus the availability of certain resources in certain areas that make an area liveable or not (Cohen et al., 2012, p. 71). On top of that there can also be a difference in the ease which resources can be collected. In combination with the weather and for example elevation, different regions are much easier to traverse then others. So spatial factors are very influential and therefore strongly determine how favourable a certain region might be for hominins in relation to the resources that can be acquired in an efficiently enough manner (Hussain & Floss, 2016, p. 1163).

Lastly it is worth mentioning that identifying certain resources in the archaeological record can be troublesome. Plant based resources are often not identified at archaeological sites while it is likely that hominins used plant-based resources for a large variation of practices. When evaluating a site or area in terms of liveability for hominins it is important to keep this information in the back of our minds so that the most complete reconstruction can be created for an adequate comparison. This is especially relevant when sites differ greatly in climate and location (Hardy, 2018, p. 393).

4. Hominin

The fourth and final category is that which entails anything characteristic for a certain hominin which could have influenced is possibility to occupy Central Easter Europe. This debate focusses on three hominins, namely *Homo antecessor*, *Homo heidelbergensis* and *Homo neaderthalensis*. *Homo antecessor* inhabited Europe first after which *Homo heidelbergensis* followed up quickly and then successfully inhabited North-western Europe (Ashton, 2015, p. 152). This success is attributed to new innovations in technique that *Homo antecessor* did not possess. Examples are better clothing, better hunting tools such as handaxes and better processing of obtained resources (Ashton, 2015, p. 153). Continuing along this line of research it is then the question if the arrival of a new hominin also caused an expansion into Central Eastern Europe and if so by whom and which means caused this possibility for expansion. To discover if such an event took place three main categories will be discussed: Life history, technology and behaviour. Life history entails all major demographic events that happen in a hominin life such as but not limited to birth, reproduction and lifespan. These traits are strongly linked with overall fitness of a creature and thus with what can be expected of it (Flatt & Heyland, 2011, p. 9). Behaviour and technology naturally are connected with the life history of a hominin but are also strongly related with each other. To illustrate their interconnectivity one key event taking place around 500 kya is very fit as example. Around 500 kya evidence for an increase in brain size, reaching levels of at least 1200cc can be identified. This allowed for the development of possessed technology and the creation of new technologies. In order to maintain these technologies a behavioural change was needed so that they could be transmitted between individuals through learned behaviour (Ashton & Davis, 2021, p. 2). Such key events describe how certain hominins can deal with challenges as laid out in the previous sub hypothesis thrown at them. Differences between the hominins can thus be a possible explanation for why Northwestern Europe was occupied so much earlier than Central Eastern Europe.

Based on these four categories and all the potential questions that can arise within them, an increasingly detailed image can be made so that differences between Northwestern Europe and Central Eastern Europe might be identified so a conclusion can be drawn as to why there is such a big dating difference between the earliest settlement dates.

Chapter 2 – Timeline of sites located in Central Eastern Europe

In this chapter sites from Central Eastern Europe will be discussed to see what they do have to offer based on three important aspects. The dating, which is important for a proper timeline and future comparison, location and the implications that come with it, and the archaeological record meaning what has been found on these sites. The goal of this chapter is to create an overview of the oldest sites in Central Eastern Europe and record their important features as described before. This will allow us to use the findings recorded in this chapter and those previously recorded in chapter one in a comparison that will be part of the analysis in chapter three. All the sites mentioned here are generally accepted and recognized sites. The finds and dates are thus trustworthy and well fit for potential comparisons. However there have many sites which brought forward claims that would have strongly impacted the overall narrative but in the end, they turned out to not be through for various reasons. To give an impression of why certain sites are not trustworthy and why the other sites in this chapter are, the chapter will end with some examples of refuted sites and their faulty interpretations. The upcoming discussed sites in this chapter are presented in a chronological order starting with the oldest site first.

Mauer

Becoming famous because of the find of a *Homo heidelbergensis* mandible in 1907 the site of Mauer is well known and holds a position of importance in the palaeolithic archaeology of Europe. Mauer is located close to the town of Heidelberg in Germany which sits on the eastern banks of the Rhine, just within our designated research area, see figure 2.4 for the location of all sites in this chapter (Wagner et al., 2011, p. 1464). A remark to be made is that Mauer is thus very close to the eastern border of the chosen research area and may therefore not be the best representation of sites in Central Eastern Europe especially when potentially similar sites are found relatively close by on the other site of the Rhine just outside of the research area, such as Kärlich H.
The site is part of a fluvial landscape located near the Rhine but even more so it was influenced by the Neckar, a smaller river flowing into the Rhine close by. The deposited sediments in which all the finds have been found are likely part of an old meander of the Neckar (Wagner et al., 2011, p. 1465). Besides the mandible 36 lithic artifacts have been

found in the same fluvial deposits (see Fig. 2.1. While the mandible is considered to be a colluvial deposit (Haidle & Pawlik, 2010, p.144) the lithic artifacts are still sharp and do not show indications of rounding processes suggesting they are not transported by fluvial processes thus they are thought to be in their original deposit, of which most in the same layer as the mandible (Wagner et al., 2011, p. 1466). The lithics are an assemblage of scrapers, cores, notched tools and retouched flakes, all small sized (Burdukiewicz, 2021, p. 11).

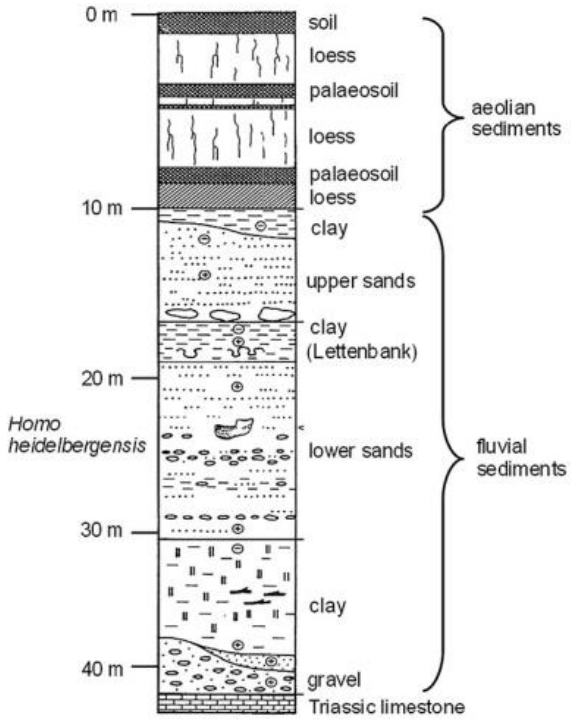

Figure 2.1 Geology and sediment layers of Mauer with the location of the hominin mandible in the stratigraphy. (Wagner et al., 2011)

The finds in Mauer have undergone extensive dating efforts. First of all, paleomagnetic dating based on the sediments of the Neckar of which the find layer consists, have shown that the site cannot be older than 780 kya since in all testable sediments normal polarity was present. On the other end a minimum age for the site is set at MIS 13 which roughly centres around 500 kya which is based on the conclusion that the find layer is followed up by at least five glacial-interglacial cycles (Wagner et al., 2011, p. 1471). Achieving a more precise date is possible at the Mauer site due to the large variety of faunal fossil remains uncovered. The key focus in the faunal assemblages is the occurrence of *Arvicola mosbachensis*, a type of rodent. Known absolute dates from

other sites indicate that it occurred from MIS 17 onwards at its earliest but for more eastern and central European sites it is more like to have occurred from MIS 15 thus putting the biostratigraphical age of Mauer between MIS 15 and MIS 13. Yet it is deemed that MIS 15 is the more likely dating as in general the faunal assemblage resembles the expectation for a MIS 15 assemblages better than a MIS 13 assemblage (Wagner et al., 2011, p. 1471). Absolute dating methods have been tried such as U-series and TL dating, but these do not provide any exacter date then was already obtained. The U-series dating gave a result of older than 300 kya and the TL dating gave a dating between 700 and 400 kya. With these datings no new information was necessarily obtained but they do align with the original age interpretations. So overall the consensus remains that Mauer is a MIS 15 site meaning it was occupied by hominis between 621 kya and 568 kya (Wagner et al., 2011, p. 1472). The large-scale correlation of various faunal remains and the sediment-based dating make Mauer and extremely reliable site. It is the oldest site in our research area which is expected since it is geographically closest located to the older sites of western Europe.
Also interesting is the environmental reconstruction made. It portrays an image of a very mild climate certainly milder than today's climate based on large mammals who lived at Mauer which are climate sensitive such as *Hippopotamus amphibius*, *Stephanorhinus hundsheimensis* and *Elephas antiquus*. Overall, it is described as a forest covered floodplain with a temperate climate. Interestingly certain specific fauna often associated with a colder and more continental climate are lacking (Wagner et al., 2011, p. 1470).

Trzebnica

Close to the large town of Wroclaw in southwestern Poland is the site of Trzebnica 2. Situated on the Trzebnica ridge the site was uncovered during an archaeological survey in an open air mine located on its slope. The force of tectonic movement initially formed the ridge after which in the quaternary roughly 13 meters of deposits were added. In the quaternary formation period of Trzebnica 2 the first layer after the Miocene period is ascribed to the Sanian glaciation. All most all following layers find their origin in various glaciation periods up until the Holocene (see Fig. 2.2) (Burdukiewicz, 2021, p. 19).
The archaeological record consists of two find layers at the site. The oldest and most numerous in finds is the oldest of the two layers, where clustered together throughout the layer in a couple of scatters the lithics number over 1500 in total Most of these are

flakes but there are also faunal remains present (Burdukiewicz, 2003, p. 71). These lithics include everything a flintknapper would produce and need during the process of creating a tool and incorporates various end results consisting of both large and micro tools (Burdukiewicz, 2021, p. 19). Burdukiewicz (2003) suggest that these microlithics were in fact so small that the only possible way to wield them would be to insert them in a haft. The other find layer is a little bit younger and can most likely be traced back to the Elstarian glaciation (Burdukiewicz, 2003, p.67). Overall, the artifacts from this second layer were much smaller than those from the older layer and were in less quantity, numbering around 220 in total (Burdukiewicz, 2003, p.69).

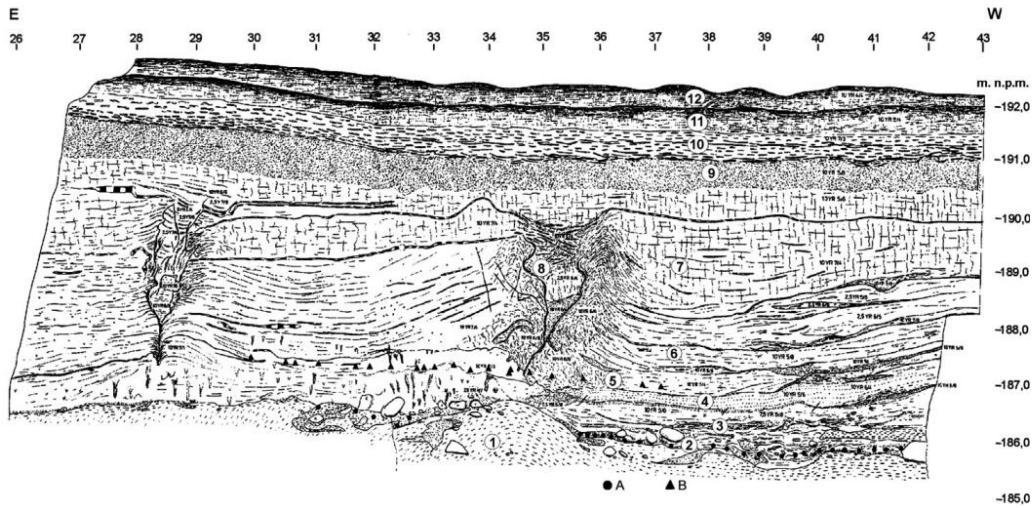

Fig. 10. Trzebnica 2 (Poland): Southern section: Tertiary: 1 – Upper Miocene clays; Sanian 2 Glaciation: 2 – sands and gravels (with lithic artifacts and faunal remains); 3 – residuum of lodgement till; Odranian Glaciation: 4 – sand, 5 – sand and gravel (with stone artifacts), 6 – sands, muds, locally clayey varved muds, 7 – silty diamicton; Lublinian Interglacial: 9 – soil lessivé; Wartanian Glaciation: 8 – pseudomorphoses from ice wedges; Eemian Interglacial: 10 – residuum of It2 horizon, soil lessivé; Vistulian Glaciation: 11 – silt; Holocene: 12 – recent soil; Archaeology: A – lower horizon, B – upper horizon (after Burdukiewicz, 2003).

Figure 2.2 Stratigraphy of Trzebnica 2 with a description (Burdukiewicz, 2003).

The focus of Trzebnica 2 lies with the older find layer, deposited during the Ferdynandovian Interglacial (part of the Cromerian complex), which is dated to MIS 15-13 as that is the layer offering evidence of the oldest hominin occupation at the site. The evidence for this claim is almost solely based upon the sediment chronology. There is a bit of support for this finding which is based on the fact that the faunal assemblage is similar to that of Mauer which has a similar age estimation. The lithics lack uniformity, uniformity is generally regarded as a feature of middle palaeolithic sites, since this is not present at Trzebnica 2 it would be in support of the earlier dating of MIS 15-13 (Burdukiewicz, 2003, p.72). The finds are thus mostly dated on the basis of the

sediments. This is not much data compared to some of the extensive datings done at the other sites. On top of this, work that the brickyard conducted on the site could have drastically altered the sediment layers and could have potentially moved around the artifacts. Therefor dating obtained from an absolute dating method would be beneficial for the overall reliability of the site. Yet there is no reason as to strongly argue against the dates given. The sediment layers are quite large and should thus be easily identifiable. Even if the dates were to shift a bit Trzebnica 2 would still remain one of the oldest sites in the region.

The faunal remains consist of animals that have been adapted to live in temperate climates suggesting that Trzebnica hosted a milder climate than it does nowadays. Remains consist of rhinoceros, boar, bison and deer. These animals were mostly forest dwellers but can also live in open environment, an image which is confirmed by the pollen record. Deciduous trees such as elm, ash and poplar are present in the pollen record of the MIS 15-13 with indication that the forest was located on alluvial sediments. Afterwards the environment seems to shift into a pine forest according to the pollen record (Burdukiewicz, 2003, p. 67; Burdukiewicz, 2021, p. 17).

Tunel Wielki Cave

About 20 kilometres north of Kraków in the karstic region of Kraków-Czestochowa Upland lays the Tunel Wielki Cave site. The cave has 5 main groupings of sediment layers. The top two layers, layer four and five, are homogeneous with all other cave sites in the region and host sediments from MIS 2 till the modern day. Layer 3 hosts a mixture of silt and loam. This layer has evidence for some sort of channel infill as sings of erosion are present in this layer. Layer two is made up from mostly loam with limestone debris mixed in. Here at the top of layer two is sublayer F located in which the evidence for occupation by hominins is found in the form of lithic tools. The last and lowest layer is connected to the bedrock floor and mostly fills in irregularities in the original cave floor (Kot et al., 2022, p 4-5). The lithic assemblage from the Tunel Wielki cave consists of 43 total artifacts. Of these lithics ten are cores while the others all fall within the flake category albeit as a tool or retouched flake (see Fig. 2.3). The flakes and tools are comparatively large which possibly stems from the abundance of local resources as there are natural deposits located at 50 meters from the cave entrance. Due to post-depositional damage such as weathering it was however difficult to discern intentional

retouched flakes from those abraded after deposition. Overall, there was no general cohesion found between the lithics and their knapping techniques besides the identification of freehand techniques and bipolar on anvil technique (Kot et al., 2022, p. 5-9).

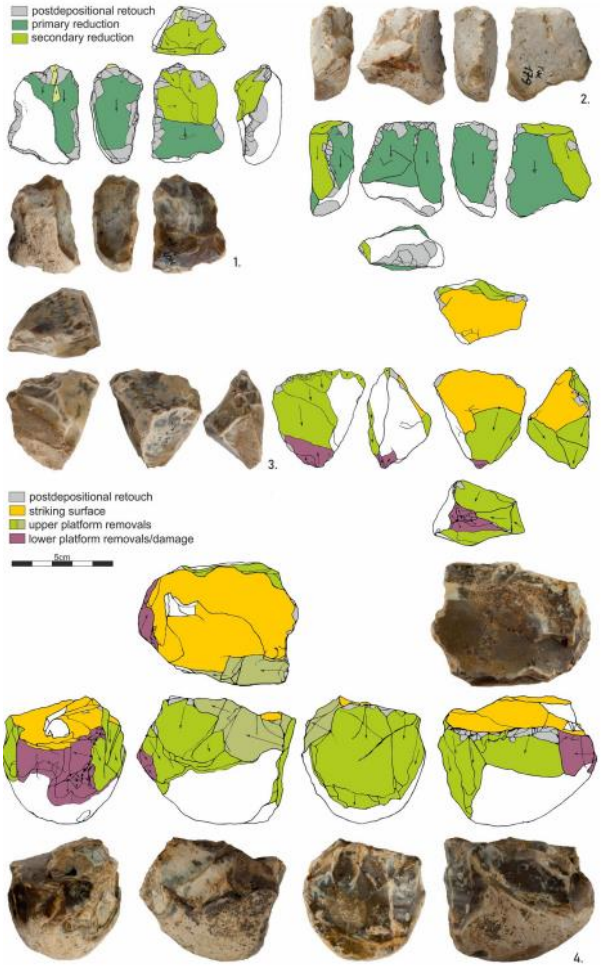

Figure 2.3 Various flint artifacts from Tunel Wielki Cave. 1 & 2 are cores on flakes 3 & 4 Cores made on flint nodules. (Kot et al., 2022, p. 7)

Kot (2022) states that the bipolar on anvil knapping techniques displayed at Tunel Wielki cave show a similar level of intricacy as tools knapped in various Mode-1 assemblages. This is noteworthy as often in the middle Pleistocene this is only done when material is scarce or of low quality which is both not the case at Tunel Wielki Cave (Kot et al., 2022, p 12-13). However, this statement must be revised a bit as the reality is more nuanced than portrayed here. The comparison on the usage of the bipolar on anvil technique is done with the site Pont-de-Lavaud, discussed in chapter one, which is roughly 500.000 years older than Tunel Wielki Cave. Therefor it is not to be expected that these sites

resemble a similar level of technique and behaviour. The choice to use bipolar-on-anvil technique likely also depends on other circumstances such as mobility, environmental restraints or other economic choices.

The oldest layer in Tunel Wielki cave is dated between MIS 15-13 but for this layer no conclusive evidence for hominin occupation is found as of yet. The oldest occupation layer is a bit younger where the dates are derived from the faunal remains present in the sediments. Absolute dating methods were not used (Kot et al., 2022, p. 2-4). A collection of various rodent fauna remains originating from different species such as *Arvicola mosbachensis*, *Allocricetus bursaei* and *Pliomys episcopalis* among others was found in the oldest occupation layer. This specific combination of rodent taxa allowed for a correlation with the Early Toringian. As these layers were deposited in both a glacial as well as an interglacial stadia, they translate the best with a dating of MIS 14-11 (Kot et al., 2022, p. 3). Combining this with the data of the carnivorous fauna in those layers the human occupation period can be narrowed down a bit further resulting in a final occupation date of MIS 14-12 (Kot et al., 2022, p. 11).

No strong paleoenvironmental data is available for Tunel Wielki Cave or its surrounding area. The little bit of evidence we have is based on small mammal fossils which seem to indicate a change in environment around MIS 16-14 represented by a change in the faunal record with the occurrence of *Arvicola mosbachensis* and the disappearance of *Mimomys savini* (Berto et al., 2021, p. 66). It is likely that a trend towards a more colder tundra environment started which could have been the onset for the more general trend of an increase in a colder Tundra climate during MIS 12. While there might thus have been a trend of the climate becoming cooler during hominin occupation of Tunel Wielki it does not reveal what the starting point was from where this cooling began. Results from a wood charcoal analysis point at a mild climate as the analysis revealed that the piece of charcoal is beech (*Fagus)*, a deciduous tree favouring temperate climates. Further conclusions are however difficult to make since there is no pollen record available (Kot et al., 2022, p. 18). Another interesting factor is the start of the occurrence of large fauna including mammoth species as it likely indicates the start of a cooler period on the onset of MIS 12 (Kot et al., 2022, p. 11). It is unclear whether this might have affected the continuous occupation of Tunel Wielki Cave, but it does raise questions concerning the technical capabilities of the hominin residence of the site in relation with keeping warm and fire use and control. Especially when combined with the fact the caves systems in Central Eastern Europe such as Tunel Wielki Cave have a higher

humidity and a lower average temperature than caves located in Western Europe (Kot et al., 2022, p.13).

Figure 2.4 Map of Europe with sites indicated mentioned in this chapter. 1 Mauer, 2 Trzebnica, 3 Tunel Wielki Cave, 4 Bilzingsleben, 5 Rusko 33 and 42, 6 Schöningen and 7 Bisnik Cave. Original map from Wikipedia edited by author (www.commons.wikipedia.org).

Bilzingsleben

Another famous site in the discussed research area is the site of Bilzingsleben. Roughly located in central Germany the site itself sits within a mountainous zone. On a more local level the site has a strong fluvial context. The valley and the Wipper river that flows through it in which Bilzingsleben can be found has connections with large river systems

such as the Elbe and Saale (Mania & Vlček, 1981, p. 134). The valley where the archaeological site of Bilzingsleben is located, is build up out six geological terraces all formed in six separate glaciation periods. Upon each of those terraces are interglacial travertine sediments separating the main terraces from each other. The layer in which the archaeological finds originate from is marked by a sandy deposit of an old and now gone lakeshore. These sands were later covered by the travertine layer making excellent preservation circumstances. It is within this sandy lakeshore layer where the archaeological finds have been found (Burdukiewicz, 2021, p. 27)

The hominin fossil remains come from three separate individuals and through time have been ascribed to *Homo erectus,* pre-Neandertal, archaic *Homo sapiens* but the latest studies have ascribed the fossil remains to *Homo heidelbergensis* (Haidle & Pawlik, 2010, p. 144). Hominin finds like these are important as they tell us about a possible connection between hominin species and the capabilities of occupying Central Eastern Europe. The determination that the hominin remains belong to *Homo heidelbergensis* and not to *Homo erectus* is significant as it gives basis to the theory that revolutionary changes were needed to colonize Central Eastern Europe, something that the first occupants of Europe, *Homo erectus*, did not have or was perhaps not capable of achieving.

The lithic finds consist of both large tools with a variety of purposes and smaller tools which mostly consist of denticulated scrapers and points. The lithic artifacts have been found in enormous quantities totalling well over 100.000 (Burdukiewicz, 2021, p. 27). None of the lithic tools found can either be seen as a handaxe or as belonging to the Levallois technique. The main method of creating tools would be to sculpt a natural blank into a desired blank and to then create the tool out of this artificial blank. This method creates a lot of flakes as opposed to when the tool is created directly out of the natural blank (Rocca, 2016, p. 216).

Based on the combination of the hominin fossil finds and the material finds an occupation period of MIS 11 is suggested (Haidle & Pawlik, 2010, p. 144). Absolute dating done on the sediments of the archaeological find layer by means electron spin resonance gave a dating of 421-320 kya (Burdukiewicz, 2021, p.26). U-series done within the same layer gave an occupation date of at least 350 kya or older. Combining this with the artifact evidence MIS 11 can indeed be seen as a good dating and general consensus for the site (Mallick, 2000, p.54). MIS 11 puts Bilzingsleben roughly around 400 kya in the Holsteinian interglacial.

The climate in the habitation period of the site is assumed to be rather temperate and in general much milder and forgiving. The taxa present at the site, commonly known as cornel, boxwood and nettle tree, is considered Mediterranean and does not naturally occur in the modern-day colder climate. Faunal remains from the site such as *Dicerorhinus kirchbergensis* and *Palaeoloxodon antiquus* confirm this temperate climate. All in all, the large-scale environment to which Bilzingsleben belongs is a mixed forest steppe environment (Szymanek & Julien, 2018, p. 67). Expectations about resource availability can be made, certainly when looking at the other fluvial sites mentioned. Assumptions about an abundance of resources is indirectly confirmed as excavations near previous water edges and deltas have yielded finds including hominin fossils and a wide range of faunal remains and stone, bone and antler tools (Mania & Vlček, 1981, p. 149-151).

Rusko 33 and 42

Just north of the Sudeten Mountain range the site of Rusko can be found. Rusko is closely located to the earlier mentioned site of Trzebnica sharing Wroclaw as its closest larger city. Stratigraphy wise the site is quite simple. The lowest layers of the site's formation are ascribed to Mesozoic layers. Various layers are then in between the oldest layer and a five-meter thick Sanian 1 layer which is followed up by a six-meter thick Sanian 2 layer. This is topped off by an Odran glaciation layer. In between these glaciation layers are smaller layers originating from interglacial stadia in which the site has been found (Burdukiewicz, 2021, p. 22). At the site an abundance of lithics have been found. At Rusko 33 a total of 350 lithics have been found in their primary context. Most of these tools are rather small. Over at Rusko 42 significantly more lithics have been found numbering 3700 in total. These lithics are more diverse in size but most of them seem to be chips and flakes (Burdukiewicz, 2021, p. 23). Furthermore, they show signs of abrasion caused by fluvial processes and are thus potentially moved to their find location from somewhere else by currents. At both sites there are almost no cores present (Burdukiewicz, 2021, p. 25). As is common for this time period in Central Eastern Europe, the lithics show no signs of any standardization let alone signs of the Levallois technique and handaxes. There is likely a connection in a common knapping technique where blanks from which the tools are created are carefully selected and shaped, which

is something also noticeable in the lithic archaeological record of Bilzingsleben (Rocca, 2016, p. 216).

The extent of dating efforts done at Rusko 33 and 42 is, when compared with other sites discussed in this chapter, lacking. There exist no absolute dates for Rusko, neither is there any faunal assemblage correlation. The only indications of a date come from a chronostratigraphic interpretation at the site. The lithic find layer is covered by an Odra/Saalian glaciation layer and can clearly be separated by a lower layer belonging to the Cromerian complex. With the deduction that the layers are of Elsterian origin this puts the lithic find layer and the date of human occupation at the site around MIS 11 (Burdukiewicz, 2003, p. 67). This does not necessarily mean that this date is unreliable, but it is significantly less supported then other the dates from other sites in this chapter are since such a date with a single origin is prone to mis interpretation caused by a wrong interpretation of sediments or by post depositional movement of the artifacts. The latter is however unlikely as the number of artifacts is incredibly high while still coming from a single layer. If post depositional movement had occurred for by example fluvial processes the scatter of artifacts would have been more spread out through different layers.

Before and during the human occupation of the site the environment was rather temperate housing mostly coniferous trees but there were some incursions by deciduous trees such as oaks, ashes, elms and even some willow. The local surroundings would have been covered by forest while also housing some fluvial elements, likely a river or stream (Burdukiewicz, 2003, p. 68). After the human occupation layer, the climate started to shift. The pollen record from a nearby lake show indications of a cold climate as yielded large number of grasses instead of the previous coniferous forest. This suggests that in a colder period after MIS 11 the forested landscape changed into a cold tundra or even a steppe landscape. However once again after this cold glaciation period the pollen record changes once again suggesting that the climate shifted towards a boreal forest and then a more temperate forest and thus a milder climate in general. This would have happened around MIS 7 (Burdukiewicz, 2003, p. 69).

Schöningen

The town Schöningen and its accompanying archaeological sites can be found in central Germany somewhat close to the larger town of Maagdenburg and on a larger scale it is

best described as being located between Hannover and Berlin. Locally the Schöningen sites are found in an open cast lignite mine (Bonhof & Kolfschoten, 2021, p. 1). Schöningen as a site consists of multiple layers and infills each with unique finds.
The stratigraphy of Schöningen is strongly influenced by the alternation of glacial and interglacial stadia. Throughout the Pleistocene this alternation caused the build-up of multiple sediment layers. Within these layers are six separate infill channels visible all dating from a different glacial cycles. Channel one is the oldest while channel six is the is youngest finding its origin in the near the Holocene (Richter & Krbetschek, 2015, p.48). Channels one and two are the most important as they house the oldest and the most unique finds respectively. During the Elsterian glaciation the advance of the land ice brought with it a flow of melt water which ran underneath the ice sheet. This caused erosion and left a depression in the landscape which during following glaciations was once again used for the drainage of melt water while in the interglacial stadia the depression caused a lake to form at is location (see Fig. 2.5). The lake and the surrounding valley likely boasted high quantities of resources which attracted large numbers of fauna as well as early hominins (Lang et al., 2012, p. 100).

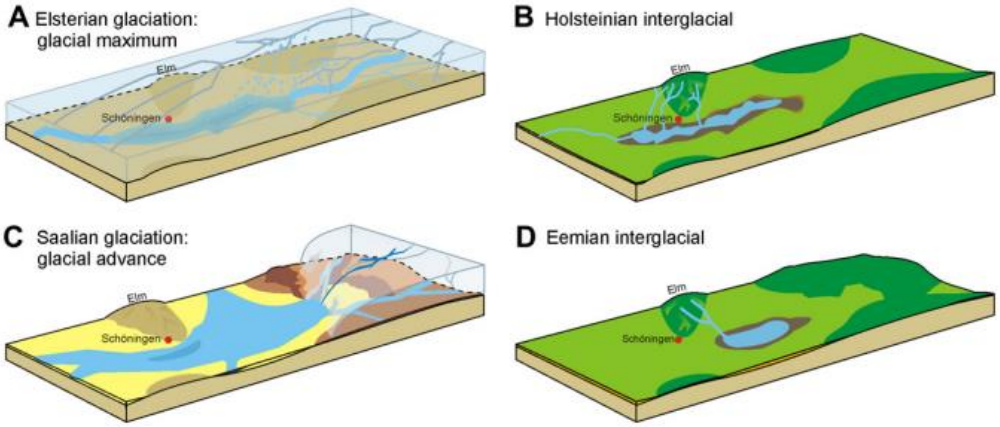

Figure 2.5 Reconstruction of four different stages and geography at Schöningen. The occupation discussed in the text is linked with stage B. (Lang et al., 2012).

Schöningen 13 I

Schöningen 13 I is important as it is the oldest site at Schöningen with hominin occupation evidence. The site lies at a previous lake shore.
Within the archaeological layer is an abundance of natural flint which has been brought to the site by glacial forces. Due to the presence of natural broken flint identifying

hominin flint tools is difficult. The lithics that have been ascribed to hominin tool creation are small flakes and notched flake tools. The technological skill required to make these types of tools is relatively low and so the tools are categorized as lower palaeolithic tools (Richter & Krbetschek, 2015, p. 49).

Previously Schöningen 13 I had been dated to 470±60 kya this was concluded from a single thermoluminescence which is now deemed to have been inconsistent. A revision done on the basis of multiple TL datings on different pieces of flint gave an average of 321±16 kya (Richter & Krbetschek, 2015, p. 53). The newer date is more in line with general expectations and the climate record discussed below. Since the stratigraphy of the site tells us that Schöningen 13 I predates the Elstarian glaciation with an age of 470±60 an argument could be made that this is not possible since there would be a collision with interpretations of when those events took place. A date of around 420 kya does also not fit with the climate reconstruction as discussed below.

Based on the faunal record Schöningen 13 I it is clear that a mix of both open habitat and forest habitat occupied the region. The small mammal fauna record mostly includes species that prefer an open tundra or steppe environment such as *Lemmus lemmus* and *Microtus arvalis* or those who can live in an open environment as well as a more forested environment namely *Apodemus sylvaticus.* The large mammals found at the site do prefer forested environments much more then open ones. These species are *Palaeoloxodon atiquus, Bos primigenius* and *Megaloceros giganteus*. This concludes a fauna record with species who cannot decisively be ascribed to either a cold open climate or a closed temperate climate (Kolfschoten, 2014, 476). Leaning to neither side of the extreme, a mixed environment is indicated likely a bit cooler than the interglacial environment of MIS 9 and thus predating it.

Schöningen 13 II & 12 II

These two sites have been grouped together as they are all from the same channel infill while they are also considered to be contemporaneous with each other (Lang et al., 2012, p. 103).

Besides faunal remain Schöningen has provided us with a large range of palaeolithic tools including flint, bone and wooden tools. Most famous of these tools are the wooden spears found at Schöningen 13 II-4 (see Fig. 2.6). It is these incredibly well-

preserved spears that turned Schöningen in one of the most important and famous sites of Europe in general. Out of the four complete spears three of them have a striking resemblance with modern day javelins in terms of dimensions (Schoch et al., 2015. p. 220-222). The spears are strong evidence of systematic hunting activities practiced by the hominins who occupied Schöningen. It is suggested that the makers of these spears would have been *H. heidelbergensis* although early *H. neanderthalensis* are also considered a contender (Schoch et al., 2015. p. 214).

Figure 2.6 Four wooden spears from Schöningen. (Schoch et al., 2015, p. 215).

Naturally to create these wooden tools flint tools were needed. These have been found in abundance at the site, numbering around the 1500 lithics in total. Most of these lithics are small flake and other offspring created by retouching. However, there are also relatively large amounts of sidescrapers, points and perforators (Burdukiewicz, 2021, p. 32). Even though large numbers of lithic artifacts are present there is no clear evidence for lithic tool creation and thus it is assumed that the lithic debris originates mostly from conducting maintenance and repairs on already existing tools. This would be in line with the notion that the Schöningen site was a butchering site and not the main place of

habitation, an assumption which seems logical based on the large number of horse remains and the wooden spears (Haidle & Pawlik, 2010, p. 150). The last type of tools found are metapodial hammers made out of bone and come from Schöningen 13 II-4, the same layer as from where the wooden spears were uncovered. The bones used come from the butchered horses at the site. It was suggested that the bones were used for two main tasks namely for knapping flint on site as part of maintenance of the tools during the butchering processes and secondly as hammers to extract marrow from other bones (Kolfschoten et al., 2015, p. 255). In spite of these two logical assumptions no conclusive evidence could identified in a follow up study for the use of metapodial hammers during flint knapping at Schöningen 13 II-4. It was however confirmed that the bones were indeed used in order to crack bones as very successful tools in the marrow extraction process (Bonhof & Kolfschoten, 2021, p. 9). Overall, based on the three different tool type it can be concluded that Schöningen was part of a transition period. This is marked by the high degree of variation in the level of techniques used. In general, the absence of evidence for Levallois technology qualifies the site as Lower Palaeolithic (Bonhof & Kolfschoten, 2021, p. 10).

While dating of the Schöningen sites has always been a bit unclear as earlier works tend to overestimate the age, there is now a consensus that both Schöningen 12 II and 13 II must be from the same Interglacial namely MIS 9 and not MIS 11, reducing the overall age by around 100.000 years (Lang et al., 2012, p. 103; Kolfschoten, 2014, p. 478). Various methods of dating, both absolute and relative, have been used. Foremost biostratigraphy models played a key role in obtaining a proper date. By correlating the fauna remains at Schöningen II with other established sites such as Boxgrove and Bilzingsleben it is concluded that the species found at Schöningen were younger and could not have originated from the same MIS 11 interglacial (Kolfschoten, 2014, p. 478; Richter & Krbetschek, 2015, p. 48). U-series was the only executable method for Schöningen II but according to Richter & Krbetschek (2015) it should be handled with caution as the U-series dating had to be done on peat. Peat is considered an open system thus there is always the possibility of new matter entering and contaminating by bringing outside material into the system. By incorporating five U-series dating together a mean of 300 ± 18 kya was given as a date for Schöningen 13 II (Richter & Krbetschek, 2015, p. 49).

Thanks to the abundance of research done at Schöningen it is possible to get an adequate image of the climate and local environment at times of the hominin occupation. The site itself used to be located at the edge of a lake. This meant that due to fluctuations in the water level of the lake a delta system formed turning the surrounding area into a fluvial landscape (Lang et al., 2012, p. 102). A mixed environment can be derived from the extensive faunal assemblage as it includes various species who prefer a forested environment while on the other hand there are species who would prefer a more open environment. Overall, this combination of grazers and browsers results in an image of a temperate mixed environment which houses both forest patches but also steppe patches in an interglacial setting (Kolfschoten, 2014, p.477) with an annual temperature of two-three degrees warmer that nowadays (Burdukiewicz, 2021, p. 29). More supportive evidence for this climate sketch is found through the famous wooden spears. The spruce spear showed small tree rings which can be related to the used trees slowly growing during their live time which is a proxy for a cooler climate (Schoch et al., 2015, 222). This would be contra dictionary with the earlier statements from Kolfschoten (2014) and Burdukiewicz (2021) who proposed a temperate interglacial climate. Yet this is not the case, for the wood used in the crafting of the spears was obtained at higher altitudes in the relatively nearby Harz mountains. These higher altitudes naturally explain the difference in climate as higher elevations often mean a cooler climate (Kolfschoten et al., 2015, p. 261). Combining the climate information from both discussed Schöningen sites a trend towards a more temperate climate and more hospitable conditions can be seen. As we know that the younger site is closer towards an interglacial maximum it is a logical assumption, yet it is impossible to know how noticeable this difference would have been for the different hominins occupying the site and how much of a difference it had on their respective lives.

Bisnik cave

Bisnik cave is a cave site located in southern Poland, more precisely on a hillside 405 meters above sea level in the Wodaça valley which is part of the Smolen-Niegowonice hill chain. The cave has a long and clear occupation history consisting of over 20 layers. While most habitation happened in the middle palaeolithic the cave has been used by hominins in the early palaeolithic (Cyrek et al., 2009, p. 5). While the Bisnik cave site

consists of 20 layers, for our research layer 19 is the key layer to discuss and investigate as this is the layer with the oldest hominin occupation evidence.

The stratigraphy of the Bisnik cave consists of 23 layers. The bottom layer is rests on the limestone bedrock floor and is a mix of limestone rubble and loam. The following layers up until the start of layer 13 are all silty loam sediment layers with little influence from outside of the cave. The next section consists of layer 13 till layer 8. These layers have a similar loam composition however there is a sandier influence instead of a silty one. Layers seven, six and five are sand layers originating from processes happening outside of the cave. They were most likely deposited during a partial collapse of the caves ceiling. Layers four, three and two are once again loam layers with a mix of sand and silty. These sediments have been influenced by wind processes blowing them into the cave. The last layer, layer one, is a the most recent deposition and took place during the Holocene. It consists of a mixture of silty and sandy loams with a humus layer (Cyrek et al., 2009, p. 6-10).

In total 52 artifacts were found in this layer 19 along with various fragments of animal bone. Cyrek et al. (2009) identify most of these lithics as belonging to the Levallois technique or some proto-Levallois form, but they do note that due to the low number it is difficult to draw any strong conclusion about whether they would be the oldest Levallois tools originating from this area of Europe.

Layer 19 is split up into two sections namely 19 abc and 19. The oldest part of this layer, 19 abc, predates the Odra (Saalien) glaciation and has been dated twice by means of thermoluminescence. TL dating on the sediments of layer 19 abc has given a date of 569±182 kya and the TL dating on the lithic artifacts resulted in a date of 568±131 kya, but it is still ascribed to MIS 9 even with those dates. This led to some doubt about the interpretations of layer 19 abc. This layer is namely assigned to MIS 9 which naturally does not match with the two suggested TL datings. The follow up layer to layer 19 is layer 18 with a TL-dating of 230±60 and 279±97 kya. The discrepancy between the two layers is clear. It is unlikely that two successive layers would have such a gap between deposition date and if the dates are correct, it begs the question of what happened in between those dates and why there is no other deposit separating them. According to Krajcarz et al. (2014) Layer 19 as a whole should be ascribed to MIS 8 instead of MIS 9 which would considerably lower the age of the site. Krajcarz et al. (2014) give a couple of reasons. First, they argue that MIS 8 fits better with the TL dating of the sediments they obtained. Secondly the interpretation of sediments was incorrect and was biased

towards and older age due to older alluvial sediments being washed into the cave and making up large part of layer 19 causing a destroyed sediment structure (Krajcarz et al., 2014, p. 14), on top of that the washed in sediments likely disrupted the material record by transporting materials along with the sediments too other positions deeper within the cave (Krajcarz et al., 2014, p. 16). Lastly it is argued that MIS 8 matches better with the paleoclimate reconstruction made (Krajcarz et al., 2014, p. 18) which is also supported by Socha (2014). Lastly when comparing the lithics from Bisnik cave with other sites of the oldest presumed age of 568±131 kya there does seem to be some difference. Cyrek et al. (2009) notes that the lithics found resemble some signs of the Levallois technique. However, when we look at the other sites in this chapter especially those of a similar age such as Bilzingsleben there is no connection with the Levallois technique noticeable on the lithic tools from those sites. This places Bisnik cave outside of the general trend which it would not necessarily be with a younger age thus it is another argument as to why a MIS 8 dating fits better. Yet there does not seem to be a clear response or explanation towards the TL of the burned lithics yielding a date of 568±131 kya done by Cyrek et al 2009 leaving the door open for a much older occupation event then MIS 8 (Krajcarz et al., 2014, p. 16), perhaps illustrating a short-term occupation period that ended with the start of the Odra glaciation period. Overall, the idea that layer 19 belongs to MIS 8 receives more support and is the more trustworthy dating. Without further evidence any guess is as good as another when it comes down to what the date of the lithics really tell us.

Extensive environmental reconstructions illustrate that after a warm period in which the oldest layers, layer 23-20, were deposited, layer 19 shows indications of a cold climate which is in line with the assumption Cyrek et al. (2009) make that layer 19 is partly deposited during the Odra (Saalian) glaciation. Faunal rodent remains found at the site confirms this as well describing the climate of layer 19 as boreal (Socha, 2014, p. 76). From layer 18 and onwards the climate is transitioning towards a much more temperate continental climate in combination with less precipitation, this resulted in over less precipitation with long periods of drought lasting till around MIS 6 (Socha, 2014, p. 76). A general trend can be derived from comparing both layer 19 and 18. Layer 18, dated to 230±60 and 279±97 kya by means of TL-dating, is deposited in a warmer climate than the climate was at times of the deposition of layer 19 thus illustrating a trend of an overall increase in temperature, yet both climates should be seen as cold climates. Even though there is a trend indicating rising temperatures this does of course not mean that

there could not have been intervals in which the temperature average dropped a bit. (Cyrek et al., 2009, p. 13). The landscape around the cave was generally dry and open, however the valley near which Bisnik cave is located was instead a marshy wet area. Faunal remains confirm the presence of patches of forested areas as well as the assemblages consists of species that prefer forested habitats and species that prefer steppe habitats. Thus, the area around Bisnik cave appears to be a highly diverse landscape. This can only have been advantages for early hominin residents of Bisnik cave as it allowed them to obtain a wide variety of resources of both fluvial and terrestrial origin. Potentially it is this variety of resources that made the area around Bisnik cave very resilient so that the cold climate present was less of an obstacle as it might have been other less diverse regions (Cyrek et al., 2009, p. 26).

Chapter 2.1 - Debunked sites and research problems

Many more sites than those detailed above have been discovered in our research area. Sometimes sites are claimed to be older than they actually are and are therefore later refuted and reinterpreted as much younger or as not being an archaeological site at all. Especially in this field it is important to have certainty as overall the quantity of sites is quite low, so a single site of an extraordinary old age could have immense impact on the research field and the overall narrative. This part of the chapter will illustrate some causes for these mistakes are how they made and the inevitable rectification by the hand of some examples.

Konczyce Wielkie 4

This site can be found in Southern parts of Poland in the Ostrava Basin close to the modern-day border. The stratigraphy of the site is built up by multiple layers which have been brought there through the means of glacial and fluvial processes. The find layer at the site is located at a depth of 16 meter and consists of fluvial sands and some loess sediments. It is followed up by a distinct grey layer filled with boulders belonging to the Narevian glaciation (Foltyn et al., 2010, p. 1890). The Narevian glaciation is contemporaneous with the Cromerian complex glacial A, giving the site a date of at least 700 kya. Such a date would put Konczyce Wielkie 4 in the same age group of the famous sites of Pakefield and Happisburgh. With an age like this it could have been a

breakthrough in the research field of early hominin occupation of Europe as it would show that the early hominins did spread through Europe in a more equal manner, but it was not to be so. The arguments against the findings of Foltyn et al. (2010) consist of multiple sub investigations in which both the interpretation of the lithic artifacts and the stratigraphy is targeted.

The argument for the stratigraphy is quite simple and straight forward. It is argued that the interpretation done is simply wrong which is caused by failing to incorporate other previous research on similar local stratigraphy. Research from the local area and from similar strata in the Czech Republic has yielded completely different results while being based on multiple C14 and TL-datings. On top of this an argument is made that the presence of loess in the sediments means the age estimate has to be younger as it is generally expected to have been deposited in later stages as earlier loess deposits were destroyed by glaciation and ice sheet advances. Overall, the conclusion is that the stratigraphy of Konczyze Wielki is no different than other stratigraphies in the region and is thus no exception to the rule meaning the older dating and interpretation from Foltyn et al. (2010) is incorrect (Wisniewskie et al, 2014, p. 198-199).

50 flint pieces have been discovered at Konczyce Wielki in total. The following tests have been done by Wisniewski et al. (2014) on a selection of 28 flint pieces. Comparisons between the Konczyze Wielki lithics, the Wallendorf and Wangen lithics and natural flint pieces from nearby Mokrzeszów are the basis for this research. The characteristics and difference of these 28 pieces of flint were compared in accordance with eleven different categories. To name a few: bulb of percussion, ripple lines and dorsal flake scars. With the help of chi-square test it was concluded that there are significant differences between the lithics indicating that the Konczyze Wielki lithics are not in line with the average lower palaeolithic assemblages. When assigning attributes to the characteristics of the lithics and plotting them together in a single figure it is easy to see that the Konczyze Wielki lithics deviate enormously from hominin made lithics but are similar to natural lithics and should therefore be seen as geofacts instead of artifacts (see Fig 2.7).

Yet there is even more to discuss concerning the lithics. The origin of the flint is also causing debate. The assemblage includes flint with many different origins. 40 percent of the flint is not local. The sources of those flint pieces vary in distance with the closest piece being from 60 kilometres away while the furthest piece originates from a source 250 kilometres away.

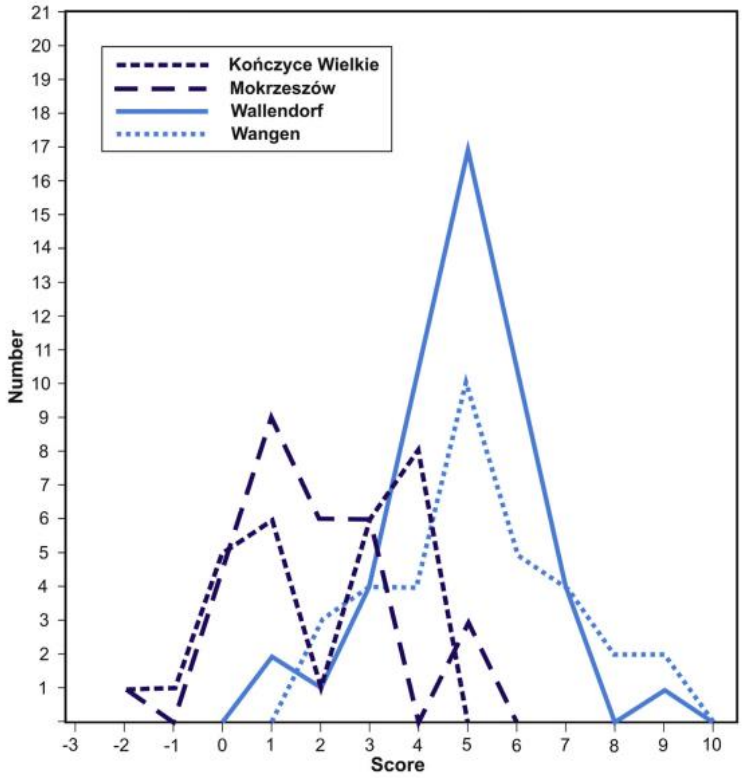

Figure 2.7 Conclusive score for the lithic comparison illustrating the difference between the lithics (Wiesniewski et al., 2014).

This extreme transportation of flint is something simply not seen in the lower palaeolithic, especially when local flint of good quality is readily available. Proposed behaviour like this is thus extremely unlikely to have taken place (Wisniewski et al., 2014, p. 195).

The accumulation of strong arguments against the interpretation of Konczyze Wielki refute the original claims of it being a 700 kya hominin occupation site. The mistake made by the original author can be concluded as a lack of exactitude. Interpretating the geofacts for artifacts could have been prevented had they been examined with a more critical view, especially when the site as a whole was better placed and compared with other sites in the region. On top of this the wrongful interpretation is something Roebroeks & Kolfschoten (1994) already advocated against as they described how a site must be of hominin origin beyond any reasonable doubt. This thus means that single artifact scatter containing mostly if not solely geofacts does not qualify for recognition in the earliest hominin occupation debate.

Attenfeld

The site of Attenfeld in Germany, located near the Donau in between München and Nuremberg, is an example of another dubious interpretation based on the lithics while also suffering from a language barrier. Back in 1990, a handaxe and later various flakes and cores were found. These were dated with a pedological analysis which put the lithic find layer between 500 and 450 kya. Yet this date is currently not accepted anymore as the morphology of the lithics does not match the lower palaeolithic at all but is instead much more similar to middle palaeolithic origin (Haidle & Pawlik, 2010, p. 148). A lower palaeolithic handaxe would be incredibly unique in our Central Easter European research are. As seen earlier in this chapter not a single site includes handaxes in its lithic record. The occurrence at Attenfeld with its original dating could have meant that the early hominins occupying Central Eastern Europe were more technological advanced then assumed. Naturally it is of course more likely that something resembling the middle palaeolithic belongs to that time period instead of a period in which it is completely unique.

The second factor which is troublesome for this site is the language barrier. The original publications on the site and its find from 1990 and 1993 are both written in German. Many researchers don't speak this language on an academic level meaning that there is a significant barrier when doing follow up research on the site. This means that there is much less research available and in turn it can become forgotten resulting in new research techniques which potentially could help us understand this site conclusively not being conducted.

Chapter 3 – Identifying the occupation gap

In the previous two chapters two separate lists of sites have been recorded. The list in chapter one consists of the oldest sites in the core area of Europe which mostly coincides with the sub region of Northwestern Europe where occupation occurs well before 500 kya. In the second chapter the recorded sites all lie within the research area of Central Easter Europe, where the lion's share dates to after 500 kya. With the sites described in these lists a rather complete image of the earliest occupation in the core of Europe has been created with the oldest sites in their respective region being discussed. The oldest argument by Roebroeks & Kolfschoten (1994) as to why there would not be sites older than 500 kya have been dismissed as the sites discussed have strong primary contexts and can be attributed to hominins without a doubt. This means we can rely on the information obtained from these sites to identify similarities, differences and patterns which will then help in answering the main research question and the sub questions.

From the sites in Western Europe we can see that the oldest sites are present in the southern parts of this region. These sites, Pont-de-Lavaud and Bois-de-Riquet, have dates belonging to over 1 mya. These extremely old dates are simply not present in Central Eastern Europe. For a long time already, the general consensus is that early hominins entered western Europe at the strait of Gibraltar and continued through the Iberian Peninsula up into other parts of Europe (Garcia et al., 2013, 74). Naturally it would be unreasonable to expect sites of a similar old age in Central Eastern Europe when it is located far from the original starting point of hominin colonization. This theory can be seen in the age of sites and their location in Western Europe as the oldest sites are found in the south with younger sites in the north. A fairer comparison for Central Eastern European sites is thus a comparison between sites in the more northern part of western Europe which are also further located from the original entry point into Europe. Yet when looking at the dates for Happisburgh, 1 mya - 780kya, and Pakefield, 700 kya, and comparing them with the oldest site in Central Eastern Europe namely Mauer, 621 kya - 568 kya, it is clear that there is still a huge age gap between the sites. Mauer is however located on the most western edge of our research area and is when compared with the other sites much more closely located the origin area of hominin occupation in Europe. Taking the next two sites in terms of age we would get two Polish

sites, Trzebnica and Tunel Wielki Cave. Both sites lack an absolute dating but are placed within MIS 15-13 for Trzebnica and MIS 14-11 for Tunel Wielki Cave. This means that roughly speaking these sites differ at least 200 kya years with the two British site. Consequently, this gap average only increases when bringing in other sites in the comparison as the sites in Central Eastern Europe are younger than those previously mentioned while sites in Northwestern Europe are older than those mentioned, thus increasing the median difference. Additionally, table 3.1 portraits this is as well where there literary is a visual gap between the sites in the two regions. This analysis and observation can only be interpreted as that there is indeed a significant gap between the earliest occupation date in Northwestern Europe and the earliest occupation date in Central Eastern Europe.

3.1 - Explaining the gap

The dating methods used in both research areas are relatively similar. In both regions absolute and relative dating methods are used alongside each other. A notable difference is however that some sites in Central Eastern Europe lack absolute dating method and sometimes rely on a single relative dating. When absolute dating methods are used, they are often the same in both regions with a focus on thermoluminescence, electron spin resonance and U-series. The single exception here is the use or Argon-Argon dating at Bois-de-Riquet as it is the only site suitable for this method since it has volcanic rock, something all other sites do not possess. Almost all sites incorporate some form of biochronological interpretation. In Western Europe it is used most often to help with establishing boundary dates so that an absolute dating can be interpreted more precisely. On the Central Eastern Europe sites its purpose is much more linked with and marine isotope stage correlation. While sometimes the biochronological analysis is the sole deciding factor for determining the age of a site as is the case at Tunel Wielki. Overall, we can see that the sites in Central Eastern Europe rely more on relative dating methods than their western counter parts. Variations in dating methods are not a suitable explanation for the earliest occupation gap. Even more if there are any dates that will be revised in the future it is more likely to happen in Central Eastern Europe than in Northwestern Europe. Stating conclusively there is no evidence nor reason to ascribe the occupation gap between the regions to incorrect or otherwise dubious datings.

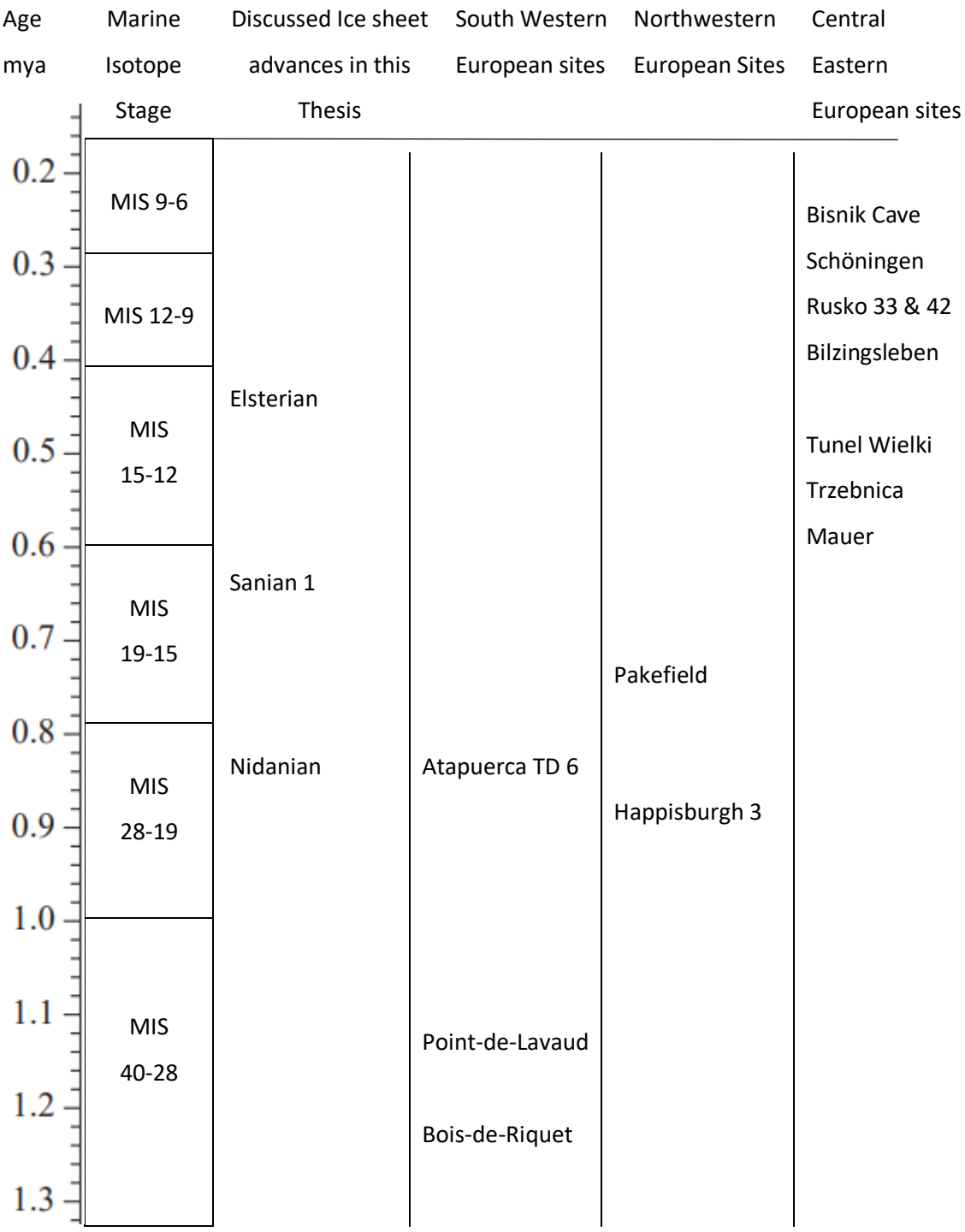

Table 3.1 All discussed sites put together in a rough overview to illustrate the pattern of the oldest occupation in its respective regions. Created by the author.

Chapter 4 – Establishing the climate circumstances and its effect on potential hominin expansion into Central Eastern Europe

The climate is a great influence in hominin lives. It dictates much of our behaviour and our actions. Understanding the climate is thus important. In an effort to understand possible reasons for the difference between the earliest occupation date between the regions of Northwestern Europe and Central Eastern Europe it is key to have a good overview of the climate situation. As climate dictates many other aspects of hominin lives directly or indirectly it arguably stands at the basis of all of the suggested hypothesis discussed in chapter one. First of all, a large-scale comparison will be made after which a more zoomed in analysis of certain relevant climate aspects is possible. The results from this can potentially reveal reasons for the difference in occupation date and will most definitely help in setting the context for upcoming analysis on the other discussed aspects. The main goal is to understand if the climate was a key factor in preventing hominins from occupying Central Eastern Europe when Northwestern Europe was occupied and then to identify potential changes which did eventually allow for occupation in both regions at the same time. All temperatures given are expressed in degree Celsius.

4.1 - Climate zone division analysis

The largest division between different regions within Europe that is useful for our analysis is based on environmental stratification in which areas in Europe are defined on the basis of different environmental factors which allows them to be group into separate climate zones (see Fig. 4.1). The three pillars on which this map is established are climate data, geographical position, and the ocean's influence. From the map we can see that today the core areas we are discussing fall almost exclusively into three categories Northwestern Europe is part of Atlantic Central zone which is marked by a moderate climate with temperatures neither on the high end in the summer and on the low end in the winter giving a very average year-round temperature. Central Eastern Europe is divided in two zones, namely Atlantic North and Continental. Atlantic North is similar to its central counterpart but due to the influence of the North Sea the temperatures are on average a bit lower. Continental is designated as an area with warm summers and cold winters, an overall larger separation in temperatures when

compared with the Atlantic zones (Metzger, 2018). The image described above is directly related to the modern-day climate of Europe but it is still relevant for our research. While the climate and geography of the Palaeolithic was naturally not identical to the situation nowadays it provides a good indication of what might be expected in certain areas when no evidence is given that might suggest otherwise

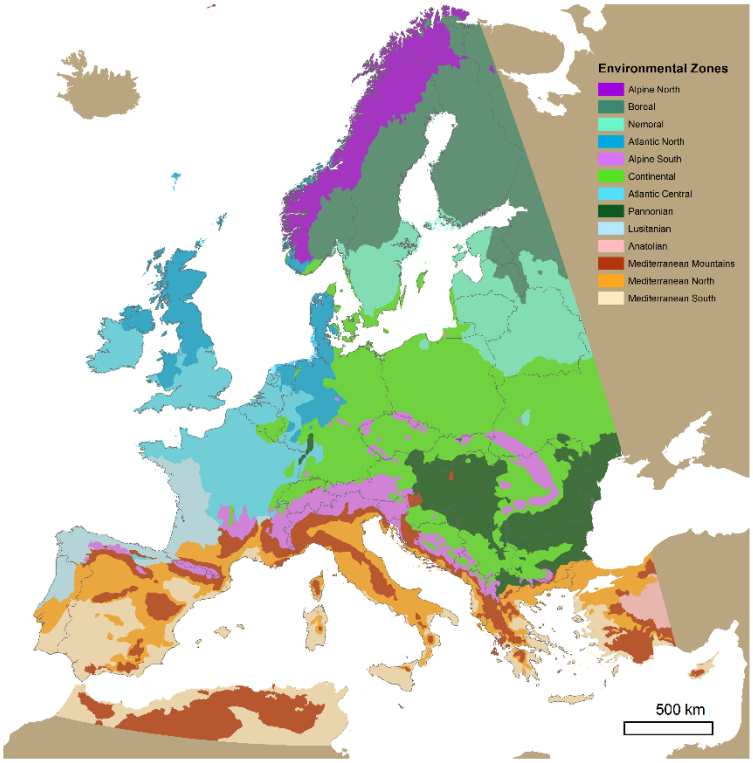

Figure 4.1 Map of Europe divided into Environmental zones. (Metzger, 2018).

If we apply the modern-day climate zone principles on our lower palaeolithic sites, it can give us a general trend that is generally to be expected in those areas. Yet there is no guarantee that modern day climate zones are a perfect match as the climate was different back then just as the geography of the land differed, think for example about the land bridge between continental Europe and Great Britain that existed. Nonetheless it does help with understanding general trends in the climate of Europe.

Happisburgh and Pakefield have always been coastal sites and while average temperatures might have differed, we know for a fact that it always had a strong long term oceanic influence from which it can be conducted that it thus must have had a relative average climate with neither harsh winters nor hot summers (Parfitt et al., 2010, p. 232). The situation in Central Eastern Europe is different. Seeing that in modern times

our research area is almost exclusively located in the continental zone it would be an easy assumption that there has always been a harsher climate when compared with Northwestern Europe. Especially as our sites are located much more inland so even differences in the palaeolithic coastline would likely not have altered this, on top of this the effects of the Atlantic Ocean are completely different then the effects of the Baltic Sea on the climate in general. We are leaving the effects of the ice sheet advances and glacial maxima out of the picture for now as that is a subject which deserves its own discussion later in this chapter. The drawbacks of living in a continental climate versus an oceanic climate are numerous and can have enormous impact on hominin live.
As said earlier the key characteristic of a continental climate is the large variations that can take place. These variations are best described in along the lines of the term seasonality. Seasonality entails all variations in temperature, precipitation, day length and available resources. This is all bound to the four-season cycle which is present in Europe (Hosfield, 2020, p. 3). In Central Eastern Europe the strongest difference in the aforementioned factors would be most noticeable when comparing summer and winter. Contrary to the general trend, which is true most of the time, there are periods in which Central Eastern Europe might also have been under the influence of the oceanic climate. Cohen et al. (2012) note that pollen records from western Russia contain ivy and holly, plants which are normally associated with mild climates much more to the west than described here. This example shows that there is variation in how strong the continental and oceanic influence is during certain interglacial stadia.

The climate before the first occupation of Central Eastern Europe, at times when there is occupation in Northwestern Europe, is described as mild. The period between MIS 21 till MIS 17 is marked by two warm phases and one cooling phase however the cooling phase does not boast a true glacial cooling and is thus relatively mild (Szymanek & Julien, 2018, p. 60). At the same time the climate in Northwestern Europe is also described as Mediterranean-like with average maximum temperatures lying within 17-23 degrees and with the coldest winter temperature only being between -6 and +4 degrees (Ashton & Lewis, 2012, p.53). During this time period there is no occupation in Central Eastern Europe. The climate in Central Eastern Europe also features two warm phases with a mild cooling phase lacking glacial deposits. Lack of a continuous record means we have to rely on piecing shorter snapshots together which point us towards an image of deciduous forests in the warmer stages and a boreal forest in the colder stage.

At the onset of MIS 17 a mild, wet and temperate climate is described yet there is still the inclusion of fauna in the archaeological record that is more suited for colder climates (Szymanek & Julien, 2018, p. 61)

When we look at the occupation circumstances of the earliest Central Eastern European sites from MIS 15 onwards, we notice not much difference with the circumstances between MIS 21 – MIS 17 and those during occupation. The oldest sites, Mauer and Trzebnica 2, both host a similar temperate climate. Mauer potentially had on average the warmest climate as is indicated by its faunal record discussed in chapter two as from MIS 15 onwards climate is overall shifting towards a cooler environment which is seen by the occurrence of a more open landscape which houses a mixture of cold and warm climate fauna. While this time period features both warm and cold phases the average January temperatures were almost always below zero degrees with possible short exceptions, however even in these periods the winter temperatures would be close to the freezing point. In the warm phases mean temperature would be -2 in January and 17 degrees in July while in the cold phases the mean temperatures would fall to -8 and 14 degrees respectively. Yet overall, the climate should however still be seen as temperate (Szymanek & Julien, 2018, p. 61).

The existence of a temperate climate is something that is reoccurring feature at all sites discussed in chapter 2 in some way. The difference in the climate between Central Eastern Europe during MIS 21 – MIS 17 and MIS 15 -12 seems minimal, similar trends can be identified with the mixture of cold and warmer periods leading to an overall mixture of both climates resulting in temperate climate as a whole. Naturally the same differentiation of warm and cold phases is present in Northwestern Europe but all in all the climate is always a bit warmer. A potential reason is the difference in climate zones between the regions. It is good to keep in mind that while the climate might average out as temperate, the most important aspect is the coldest or most extreme months as those months provide the biggest challenge during continuous occupation. Naturally, there are more aspects which influence how a climate is perceived which will discussed next.

4.2 - Cold amplifiers

Windchill is the effect of cold air flowing past the body in the form of wind which results in the cooling of the body temperature. This can be extremely problematic in cold

weather when the body is not properly insulated. Windchill causes temperatures to be experienced as lower than what they actually are, making staying warm more difficult. Maintaining a proper body temperature is one of the main challenges hominins had to face when moving into the cold winter climate of Europe. Windchill is strongly connected with the temperature as its effects are more noticeable when the temperature is already low, therefor windchill is stronger in its effect in continental and artic zones as opposed to oceanic zones (Hosfield, 2020, 266). It would have been in the interest of early hominins to avoid exposure to windchill as much as possible. A key factor in preventing exposure is the geography of a region. Overall forested areas and other geological barriers such as valleys and caves shield against windchill (Hosfield, 2016, p, 661). The need for shelter against windchill is arguably reflected in the sites occupied by early hominins in Central Eastern Europe. Every single site that had an open environment also had significant forested areas nearby or the site provided shelter through a cave or a valley that deviated in its climate from the other surrounding areas. Naturally the mix of environments cannot be solely attributed to the need to shelter from windchill but together with the knowledge that temperatures could become very low in continental climates in wintertime it is a logical assumption that hominins occupying these areas were selective about where they would live and with which environments they surrounded themselves. A lack of protection against the elements in winter times easily causes body temperature to drop which may result in hypothermia and frostbite, which becomes a possibility when temperatures reach -0,55 degrees (Hosfield, 2016, p. 676; Hosfield, 2020, p. 104). It goes without saying that this can damage the body severely and even result in death.

Another factor which can influence temperature that differs between an oceanic and continental zone is the amount of precipitation. Precipitation exists in two mains forms, rain and snow. The intensity and form vary between regions but as a general rule oceanic climates have higher numbers of precipitation in the form of rain. This is true for Northwestern Europe where precipitation is almost always in the form of rain due to its temperate climate (Hosfield, 2016, p. 655). At Happisburgh, average yearly precipitation during MIS 13 was 611 mm (Hosfield, 2020, p. 38). Depending on the intensity of the oceanic influence annual precipitation of 800 mm is not out of the question. In Central Eastern Europe the average precipitation between MIS 15 and MIS 12 was 500 mm (Szymanek & Julien, 2018, p. 61). However, in periods with strong continental influence annual precipitation could have been as low as 400 mm as is noted at Schöningen

(Hosfield, 2020, p. 79). Precipitation in the form of rain has one direct effect on hominins, they get wet when being outside. As a result of being wet it is more difficult to maintain body temperature which becomes increasingly problematic when combined with regular winter cold and wearing wet clothing. Other sides effects of rain can be the decrease of suitable dry resources for the use of fire but on the other hand larger amounts of rain, within a reasonable level, are beneficial for plant life which would provide more resources for hominins (Hosfield, 2016, p. 656). With these given factors it remains difficult to identify the most advantageous precipitation levels for early hominins in Europe. The only seeming benefit of higher precipitation levels would be the potentially increased resources, but these would not have mattered to hominins if a region is not survivable in the first place due to the cold. The lower precipitations in Central Eastern Europe would thus be more inviting however that neglects the second form of precipitation: snow. While there is less precipitation in Central Eastern Europe relatively there would be more snowfall in these areas due to the lower average winter temperatures. Snow cover is in general disadvantageous in maintaining body temperature and gives and increased likelihood at contracting frostbite when moving around. Furthermore, it reduces mobility and makes finding resources more difficult as they could be hidden underneath the snow. This in turn also affects animal populations as they might avoid areas with large snow covers (Hosfield, 2020, p. 263). Long term snow cover is much more likely to occur in a continuous form in Central Eastern Europe then in Northwestern Europe (Hosfield, 2016, p. 656). The effect of snow cover on hominin survival as a whole is difficult to measure. Snow cover also affects many animals as well, which might have been hunted by hominins but on the other hand hominin could perhaps have made use of certain technologies which can mitigate the harmful effects of snow cover, which we will discuss later in this chapter. The potential long-term presence of snow cover allows for assumptions regarding preparation of hominins to counter problems that may arise. It is suggested by Moine (2014) that certain geographical areas might have reduced snow cover or allowed for patches which could act as refugia for flora and fauna. As an example, valley slopes and hill sides are less likely to maintain snow cover due to exposure to the elements. Such observable knowledge would have certainly been known to hominins and could therefor play an important factor in winter survival. This knowledge is possibly reflected in the site locations of all the sites in the chapter 2 as they are either located on a slope or in and near a valley, apart from Mauer and Rusko. For Mauer the need to anticipate long term

snow cover was likely not relevant as the mild climate prevented this from happening in the first place. This is derived from the climate sensitive species found on the sites such as *Hippopotamus amphibius* which generally needs open water in order to survive. Consequently, it is thus unlikely that temperatures stayed low enough to freeze rivers and lakes which means that it is also unlikely that the land was covered in snow for long periods of time.

As noted earlier in this chapter the climate in Northwestern Europe has always been more favourable than the climate in Central Eastern Europe. On top of this the cold temperature amplifiers are stronger in Central Eastern Europe as well. Even though without a doubt it can be stated that the Northwestern climate was more hospitable arguments are made that hominins still had to adapt significantly in order to survive there (Key & Ashton, 2023, p. 21). It is thus the question how much more early hominins had to adapt purely based on climate if they had moved from Northwestern Europe towards Central Eastern Europe. Whether they could combat and to what extent they could negate the harmful effects of windchill and precipitation can only be answered by including other aspects such hominin technology and resource use, which will be discussed later in this chapter. However, there are suggestions such as by Szymanek & Julien (2018) that temperature was not the main selection criteria for hominins whether an area was suited for occupation hinting that the climate differences between the regions might have been less relevant then previously suggested.

4.3 - Climate induced scarcity related to vitamin C

Hominins need vitamins and minerals to survive. Yet in some areas it can be difficult to obtain those due to the natural providers being scarce as they do not live in certain climates or are difficult to obtain because of climate influence. The most prominent case, relevant for Central Eastern Europe, of this phenomenon is related to vitamin C. The easiest way to acquire vitamin C is through eating fruits and vegetables. Neglecting to do so can result in a vitamin C deficiency, which if maintained for longer periods of time can result in the eventual deadly disease scurvy (Speth, 2019, p. 174). The diet of northern European hunter-gatherers revolves strongly around meat as it is year-round available through hunting (Villa & Lenoir, 2009, 59). This could be problematic as meat generally holds low quantities of vitamin C. Naturally there are work arounds as is

shown by hominins surviving in these areas but also by ethnographic evidence of modern hunter-gatherers. The strategies to stave off scurvy by maintaining a large enough vitamin C intake can be grouped into two categories. Obviously supplementing a meat-based diet with fruits and vegetables is an easy solution. The second more drastic method is a shift in dietary practices (Speth, 2019, p. 180). The incorporation of plant foods into the hominin diet had already happened long before the first hominins set foot into Europe (Hardy, 2018, p. 394). There is thus no doubt that the first hominins occupying Northern Europe enjoyed a variety of plant-based foods which would have supplied them with vitamin C. However, when moving into colder climates the availability of plant foods decreases drastically but still even in artic climates modern day hunter-gatherers consume a variety of local plants, thus it is likely palaeolithic hominins would have done this as well (Hardy, 2018, p. 400). In the summer months availability of plant foods is unlikely to have been any problem however in the winter things might have been different. Cycling back to the effects of precipitation, the lower precipitation in Central Eastern Europe versus the precipitation levels in Northwestern Europe can mean that there are fewer edible plants available in general. Combine this with the long snow cover in Central Eastern Europe and plant foods could become so scarce that they are not a reliable method to prevent scurvy. While the snow cover in itself does not necessarily destroy or reduce the edible plants that survive harsh winters such as certain berry bushes it does make foraging them more difficult due to the plants being hidden under the snow and the general lower hominin mobility in a snow-covered landscape (Hosfield, 2020, p. 126).

The second manner to avoid contracting scurvy through a lack of vitamin C is specific dietary choices regarding the meat you consume. Meat generally contains low quantities of vitamin C with the exception of some organs and fatty parts, which are generally the parts that are nowadays eaten the least (Speth, 2019, p. 178). There are methods such as purposeful putrefaction of meat food in order to boost the amount of vitamin C intake upon eating it. Additionally complementing the diet with marine mammals, usually high in fat, and fish roe is beneficial as these specifically hold larger amounts of vitamin C (Speth, 2019, p. 180).

In a lifestyle where meat is the largest part of your diet it is thus important to eat the right parts of an animal in the right way. It is however questionable to what extent the early hominin moving into Northern Europe possessed this knowledge and those practices. Therefore, it is difficult to directly relate potential lack of vitamin C to

differences in occupation but there is still some use in a comparison between the region based on the vitamin C problem. The assumption that vitamin C intake could have been problematic for hominins moving into Northern Europe would suggest that the earliest hominins moving out of the warm southern parts of Europe did not possess any techniques or dietary practices as discussed above which help with vitamin C intake. However, what we do know is that those hominins did eat plenty of plant foods which does contain vitamin C especially in temperate regions (Hardy, 2019, p. 400). Putting this knowledge in the context that the climate in both regions was at least temperate at times of the earliest occupation in Northwestern Europe it does imply that extensive knowledge on how to obtain more vitamin C was perhaps not needed. This suggests that obtaining vitamin C would not have been a major problem and is therefore unlikely to have attributed towards the occupation gap between the regions. If vitamin C intake would have ever been a serious problem it is much more likely that it was a problem in the later environments of the colder stages from MIS 15 and onwards, however these environments are not yet present at times of earliest the occupation. At Mauer this is reflected in the exceptionally mild climate described by Wagner et al. (2011) where it seems unlikely that plant-based resources were completely gone or hidden during winter. While vitamin C does not necessarily seem to be a major problem before MIS 15 based on the climate as described by Szymanek & Julien (2018) earlier in this chapter it could still have been a more difficult to obtain plant foods and thus vitamin C in general in the most eastern and continental climate of Central Eastern Europe but not to an extent where it made occupation impossible.

Chapter 5 - Possibilities of glaciation preventing earlier occupation and or causing the destruction of evidence of earlier occupation

5.1 – Overview of glacial cycles with land ice expansion and the effect on possible occupation

The palaeolithic history of Europe has been influenced by the many glacial and interglacial cycles. During periods where the effect of the glaciation was extremely strong land ice would expend massively and cover large parts of mainland Europe. The land ice expansions varied per region in range and timing, but all land ice expansions discussed here originate mostly from the Fenno-Scandinavian ice sheet (Lauer & Weiss, 2018, p. 1). The oldest relevant glaciation, called the Nidanian, and subsequent land ice expansion happened during MIS 22 or MIS 20. This is long before any occupation is recorded in Central Eastern Europe but there is already occupation in Northwestern Europe at this time. This land ice expansion falls a bit short in size compared to the latter two, but it still covers large parts of Poland and smaller parts of Germany while hardly impacting Northwestern Europe at all (Gozhik et al., 2012, p. 32).

The next glaciation took place during the MIS 16 glacial called Sanian 1 which includes an ice sheet advance with glacial deposits that have been dated to around 600 kya (Gozhik et al., 2012, p. 33) The ice sheet had once again a more eastern focus being much more prevalent in Poland, Belarus, Russia and Ukraine. Germany was also partly covered and Northwestern Europe was once again mostly spared. In Poland the ice sheet expansion reached an all-time maximum covering even the southeastern corner which in subsequent ice sheet expansions would remain uncovered (Gozhik et al, 2012, p. 34). This glaciation predates both Mauer and Trzebnica, the only sites predating the Elsterian glaciation. Of these sites only Trzebnica is actually located in the area covered by the land ice but was occupied after this glaciation period between MIS 15-13 (see Fig. 5.1).

Figure 5.1 Maximum extent of the Sanian 1 ice sheet advance, indicated by the yellow line named S1. (Dumnicka et al., 2020, p. 91).

In our research window the first ice sheet advance that covered both Northwestern Europe and Central Eastern Europe simultaneously occurred during MIS 12 and is intertwined with the Elsterian glaciation. This cycle was cut off by the start of the Holsteinian interglacial period starting in MIS 11 (Lauer & Weiss, 2018, p. 6). The Elsterian ice sheet has multiple names which differs between regions. Elsterian glaciation is used in Germany and The Netherlands but it might also be known under the names of Anglian in Britain and Oka in Poland and Ukraine (Preece & Parfitt, 2012, p. 21). In all these regions the ice sheet advanced far and covered large areas of land including many locations which housed hominin occupation (see Fig. 5.2). In Northwestern Europe we can see that the ice sheet advance affected two discussed sites in Britain namely Pakefield and Happisburgh, but it would also have affected many other sites as occupation in Northwestern Europe was already a much more common occurrence before MIS 12. France and all the sites located there are not directly affected by the ice sheet. Following the ice sheet eastwards, it cuts through Germany right in the middle. The only site predating the ice sheet is Mauer but that lies further south than the maximum extent of the ice sheet. Moving into Poland the ice sheet follows the southern border mountain ranges closely. There is one site certainly predating the MIS 12 ice sheet advance and that is Trzebnica 2 dating between MIS 15 and MIS 13

(Burdukiewicz, 2021, p. 17). The second Polish site likely predating or being contemporary with the ice sheet is Tunel Wielki with a date of MIS 14-12. As Tunel Wielki is more in the southeastern part of Poland then Trzebnica it has not been covered by the Elsterian ice sheet. There is therefore a possibility that the site was occupied at times of the maximum ice sheet expansion of the Elsterian. Occupation at the site does not continue into MIS 11 so it is likely that the advancing ice sheet and the glacial conditions of MIS 12 forced the occupants to move elsewhere.

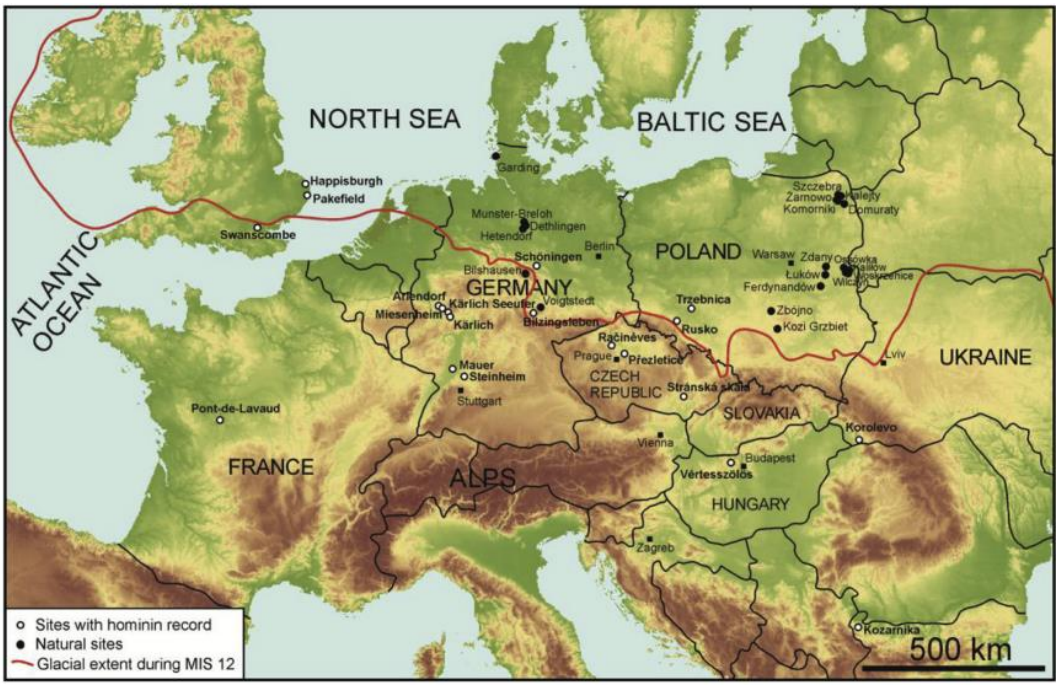

Figure 5.2 The maximum extent the land ice expansions during the MIS 12 Elsterian glaciation period. (Szymanek & Julien, 2018, p. 59)

These three events give a clear picture as to when potential occupation can be expected. Generally, it is unlikely that occupation occurred during these three land ice expansions in our research area, first of all because there is much less space left to occupy. On top of that during glacial maxima harsher climate conditions are to be expected requiring the needed for refugia areas to sort of weather the storm and allow for continuous occupation. The behaviour of the advancing ice sheets makes this quite difficult. An easily accessible and common refugia is a sheltered river valley, see for example Bilzingsleben and Bisnik cave, yet these are also the main direction into which the frontal lobes of an advancing ice sheet expand meaning that in these river valleys the ice sheet might expand much further that its general extension (Salamon, 2015, p. 11). Does this mean that it is an explanation for the occupation gap? Perhaps only partly.

It is clear that the three different land ice expansions are not beneficial for occupation especially when Northwestern Europe only had to deal with one such advance. However, when looking at table 3.1 we can see large gaps between these ice sheet advances which would have been plenty of time to move into Central Eastern Europe and occupy it. This seems logical as the climate evidence suggests that the warm periods between the glacials were very temperate and mild. The effects of the glaciation periods do point us towards the idea that continuous occupation throughout most parts of Central Eastern Europe was not feasible, a general idea that also applies to most parts of Europe as Ashton (2015) and Macdonald et al. (2012) also suggest. But the lack of continuous occupation does not mean there is no occupation at all, as is illustrated in Northwestern Europe, therefore the occupation gap cannot be explained by the direct effects of the glacial stadia and ice sheet expanses.

5.2 - Glacial effect on preservation

One of the oldest explanations for the occupation gap between Northwestern Europe and Central Eastern Europe is theory that the glaciation and the subsequent land ice expansion have destroyed the archaeological sites in this region (Lauer & Weiss, 2018, p. 2). The destructive nature of advancing land ice is not doubted and there are certainly overlaps in where this destruction would take place and where hominin sites are expected to be found. It is especially in river valleys this destruction or redeposition is to be expected (Roebroeks et al., 1992, p.558). Combine this knowledge with the fact that the front lobes of ice sheets do tend to favour river valleys in their expansions as Salamon (2015) noted, it does seem reasonable to assume a certain degree of site destruction is caused by glacial processes. However simply arguing that this is the reason between the occupation gap is to straight forward and neglects various obvious flaws in this reasoning. First of all, while Central Eastern Europe has strongly been affected by land ice expansions there are still large parts especially in Germany that have been left rather undisturbed by glacial processes (Hopkinson, 2007, 299). Secondly it is obvious that with the knowledge and the archaeological record of today, sites survived the destructive glacial forces. This is illustrated by the many sites across northern Europe which are located within the glacial expansion range and predate one or more land ice expansions. Examples of this are Pakefield, Happisburgh, Trzebnica and Tunel Wielki all sites predating at least the Elstarian glaciation and maintaining an intact archaeological

record. Cohen et al. (2012) even argues that the glacial deposits have been beneficial for the preservation of the two British sites. Naturally this does not mean that glacial forces never destroyed any site in Central Eastern Europe, but it does illustrate that working from the assumption that everything must have been destroyed is unreasonable.
Yet it is still very much a possibility that the glaciation processes had a negative effect on the archaeological record. Potentially the sites predating MIS 12 and the lack thereof are part of a bias towards finding younger sites as it is simply more difficult to find older sites especially in Central Eastern Europe (Szymanek & Julien, 2018, p. 71). This is potentially caused by the extreme build ups of Loess which cover significant parts of Central Eastern Europe. Large sediment build-ups like these can make sites completely inaccessible for archaeologists and thus they remain hidden and are not incorporated into the narrative (Tourloukis, 2016, p. 319). The inaccessibility of some sites is rather well reflected in their find location. Many of the sites in Central Eastern Europe have been found after extensive mining operations which were not initiated for archaeological purpose per se. While accidental archaeological finds are nothing new the extent of these mining operations is on such a scale that is simply not feasible for a purely archaeological purpose (see Fig. 5.3).

Figure 5.3 Open cast mine housing the location of Rusko 42. (Burdukiewicz, 2021, p. 23)

Overall, it is reasonable to assume that pre-MIS 12 sites are more difficult to find due to glacial processes it is however not possible to explain the occupation gap between the

two regions by the hand of this statement. This is based on the archaeological record and the sites found that do prove that it is very much possible to still find new sites in Central Eastern Europe dating pre-MIS 12 and pre-Elesterian. With this information we can conclude that the gap is thus caused by actual human history and not by a preservation bias due to glacial processes.

Chapter 6 – The effect of resource availability and distribution on the dispersal of hominins into Central Eastern Europe

6.1 - Raw material for stone tools

A key feature of palaeolithic hominin sites is the occurrence of flint lithics. These lithics were used as various tools and hold an important place within hominin lives. The importance of flint tools is enormous and constitutes towards the survival of a hominin. So, the availability of raw material to create these tools was potentially a major decider in the overall liveability of a region. As we can see from the archaeological record of the various Northwestern and Central Eastern European sites there is no exception in the use of lithics here, but this does not mean that there are no differences between the regions which might have impacted the liveability and the desire to expand into these respective regions.

The availability of flint is of course important for hominis but is not equally spread out throughout Europe. The flint available in Poland can for example be distinguished in five separate groups each with their own special properties making them extremely suitable for different tasks allowing for the creation of a complete toolkit (Domanski & Webb, 2000, p. 830). Yet this does not tell us about the ease with which this flint could be found in Central Eastern Europe. Thanks to the work done by Duke & Steele (2010) we do have some insightful imagery (see Fig. 6.1). Duke & Steele (2010) created a model which predicts the likelihood of tool worthy geological formations containing lithic raw material being present at certain locations. The model uses a database which houses modern day flint outcrop locations gathered mostly through surveys. Besides flint the database also includes quartzite, radiolarite, and obsidian but also has some instances of rarer raw material types such as jasper, chalcedony and opalite to name a few. Such a database can never be 100 percent complete, but the general image created here still gives an accurate overview especially regarding the more concentrated areas (Duke & Steele, 2010, p. 823).

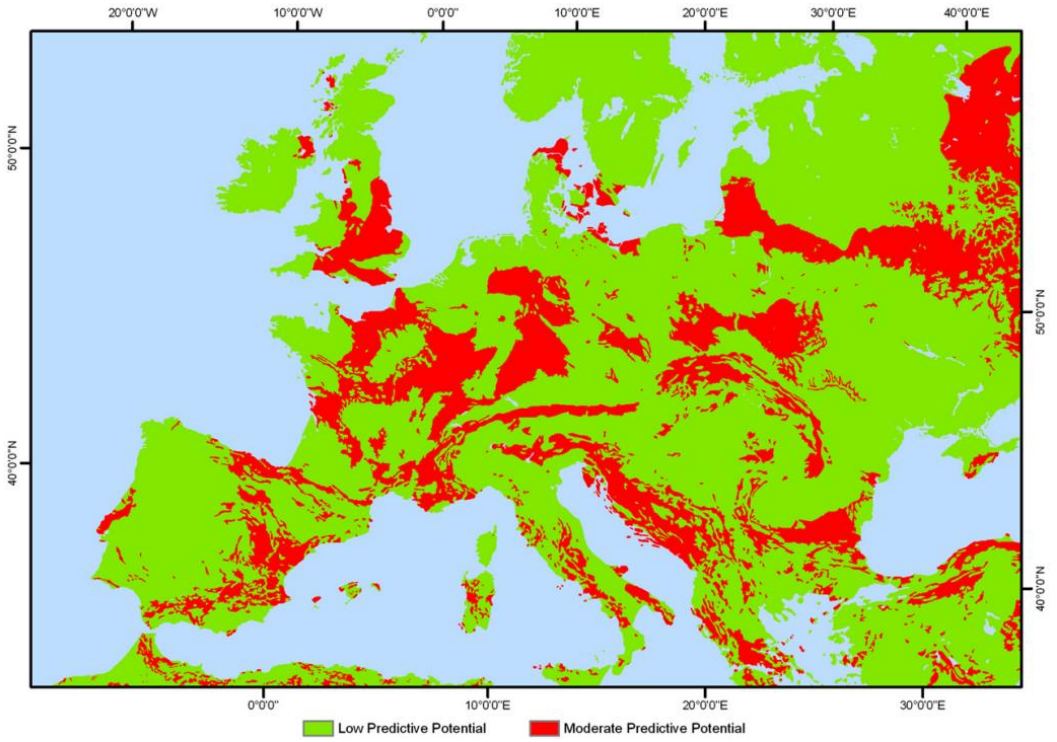

Figure 6.1 Map of Europe show the likelihood of a flint material source being present. Duke & Steele, 2010. p.823).

There are immediately a couple things that stand out. First of all, we can see that in Northwestern Europe there are large, connected areas which have raw material sources. Even more so the land in Northern France and Southern England seems to have more space with raw material sources then spaces without raw material sources. Another interesting feature is the immensely large red area in central Germany. It seems that this area corresponds roughly the main flow area of the Rhine and the Danube. In Poland the centre is completely devoid of raw material sources besides a few red specks. The Southwestern border however does host a larger raw material source patch which overlaps nicely with the Polish sites mentioned in chapter two, something that has not gone unnoticed by other as well, see Burdukiewicz (2003) and Szymanek & Julien (2018). This isolated patch is interesting. Firstly, it portrays an image of selectiveness by hominins in terms of the area where they chose to live related to the availably of raw material. Such behaviour is confirmed by the occupation around the Bisnik cave where hominins returned twenty separate times to exploit the wide range of lithic raw material available here (Sudol et al., 2016, p. 63). On the other hand, it also suggests that the hominins living there had to cross a stretch of land in which there was no raw material available.

Overall, the main takeaway is that there are a lot more areas with raw material sources in Northwestern Europe then in Central Eastern Europe and that the areas containing the raw material are generally larger and better connected in Northwestern Europe.

6.2 – The relation between Baltic Flint, the Elsterian land ice expansion and handaxes

Another part stone tool raw material discussion revolves around handaxes and the lack thereof. Central Eastern Europe's archaeological record lacks handaxes for a long period of time while on the contrary they are present in the archaeological record of Northwestern Europe. The period in which the first handaxes in Northwestern Europe are found starts roughly around 800 kya, in contrast the first handaxes in Central Eastern Europe start to appear around 300 kya (Rocca et al., 2016, p. 410), note that all Central Eastern European sites discussed do not include handaxes in their archaeological finds. Most often this has been brought forward as an argument related as to why hominins occupied Central Eastern Europe much later then Northwestern Europe. The general thought is that the local flint would not have been of sufficient quality to make handaxes, making the region not hospitable. It would therefor only be hospitable after the Elsterian glaciation as the advancing ice sheets brought in flint from the Baltic which is of a much higher quality (Lauer & Weiss, 2018, p. 2).

This theory rests on two main assumptions. Firstly, it states that the there was no raw material suitable for handaxe creation in the region before the Elsterian glaciation and secondly it implies that the handaxes is instrumental for survival in Central Eastern Europe.

Firstly, the idea that there was no high-quality raw material before the Elsterian is odd for two reasons. If high quality Baltic flint was brought in by the Elsterian glaciation it is strange to assume that this process could not have happened earlier during the two other ice sheet advances discussed in this chapter, something that is argued by Szymanek & Julien, (2018) as well. The Nidanian and Sanian 1 ice sheet advances were both significant enough and relatively similar to the advance during the Elsterian that there does not seem to be a reason why they could not have brought any Baltic flint into the Central Eastern Europe area. Secondly there is clear evidence from the Tunel Wielki site, which dates pre-Elsterian, that there was at least an abundance of high-quality local flint in the surrounding area of Tunel Wielki (Kot et al., 2021, p. 13).

Regarding the second point there does indeed seem to be a lack of handaxes in the archaeological record of the sites in Central Eastern Europe before the Elsterain. Naturally the sites before the Elsterian are rare and few in numbers but as we can see from the discussed sites in chapter two that are pre-Elsterian, namely Mauer, Trzebnica and Tunel Wielki, the archaeological record is devoid of any signs of handaxes. Consequently, you would then expect that the other sites in chapter two, who all have dates younger then the Elsterian, would have handaxes in the archaeological record as the raw material would be available if it was indeed brought in by the ice sheet advances of the Elsterian. This is however not the case. The implications are that the import of Baltic flint by glacial processes was therefore not an enormous pull factor solely based on the fact that it allowed for the creation of handaxes. It is thus unlikely that the potential lack of handaxe suitable flint in the pre-Elsterian period is a factor in the difference in occupation dates between the two discussed regions.

As the handaxes are present in the southern parts of Europe such as Spain around 900 kya but only occur after MIS 16 in the northern parts of Europe and in Central Eastern Europe only occur after the Elsterian their importance is questionable as we know that this did not have anything to do with a lack of resources or the quality of those rescources (Moncel et al., 2021, p. 1122). The question to be asked is thus whether the handaxe was an essential resource in Northern Europe for hominins. With the earliest sites in Northern Europe all lacking handaxes it does seem to point towards a direction in which handaxes were not an instrumental resource. The handaxe is not essential for survival and everyday tasks in the Lower Palaeolithic and thus is extremely unlikely to explain the occupation gap between the regions (Hosfield, 2020, p. 300).

6.3 - Food resources

Arguably the most important group of resources is everything related to food and water. Food sources can be separated into three main categories: Plant food, hunted animal food and aquatic food. The exact composition of an early hominin diet is incredibly difficult to determine due to a lack of archaeological evidence (Shchelinsky, 2020, p. 182). In order to understand more about the potential diet of early hominins in Europe ethnographic evidence from modern hunter-gatherer tribes is useful. In a study by Cordain et al. (2000) the variety of the hominin diet in correlation with the climate is

explored. From it two things become clear. Modern day hunter-gatherers incorporate all three categories of food sources within their diet and that the balance between these categories' shifts depending on in which climate the hunter-gatherers operate. A notable trend is the decrease in plant food consumption to an extent where it is less than a quarter of the diet, opposed to half of the diet and the subsequent increase in hunted animal and aquatic foods when the climate gets colder (Cordain et al., 2000, p. 686). While in modern day hunter-gatherers the decrease of plant food is mostly paired with an increasing in aquatic food, in the lower palaeolithic there is hardly any evidence for such extensive aquatic food procurement (Hosfield, 2020, p. 43). Nonetheless it is thus likely that hunted animal foods played a key role in the diet of early hominins in the colder climate of Northern Europe.

Hunting brings with it various challenges of which some are amplified in Northern Europe, it is those challenges which will be discussed here. The most important part of any hunt is finding prey. To do so large distances are often traversed to find an animal to hunt. In colder climate animal territories often increase in size as resources are generally scarcer then in warm climates. As a result, animal territories become increasingly larger which is both true for hunter and prey. Consequently, the average distance travelled during a hunt increases. The cost of hunting is thus higher as more calories are burnt during the hunt and the impact of a failed hunt is also more severe as more effort and time was expended. On top of that extended hunts mean that hominins are exposed to the elements for longer periods of time and as was discussed earlier this can be a serious issue especially in winter times when temperatures are low (Hosfield, 2020, p. 112). Continuing along this line of reasoning the next hinderance is snow cover. Snow cover is not only an obstacle for hominins but also for many prey animals. Many herbivores search for food near the ground. As the snow starts to cover the ground and builds up a layer many resources are hidden from view. The resulting difficulties herbivores encounter in finding food can cause a decrease in fat levels or cause starvation which in turn means less yield when the animal is hunted by hominins (Hosfield, 2020, p. 127). Hominins however have employed strategies to make the hunt easier and less costly in terms of the required investment. Strategies consists of ambushing animals at high value locations such as watering holes. Schöningen is often thought to be an example of this but much older examples also exist indicating that this

practice already occurred long before the occupation of Northern Europe (Shchelinsky, 2020, p. 185).

6.4 - Mammoth steppe ecosystem

Severe Elsterian glaciation of MIS 12 brought with it long-lasting changes. A big effect of this strong period of cooling was the reduction of forest which allowed fauna originating from the steppes of Asia to migrate into Europe. Here a new ecosystem and biome would form as a result of this migration, namely the mammoth steppe (see Fig. 6.2). Some examples of fauna that could be found in this mammoth steppe are, naturally mammoths, woolly rhinoceros and muskox (Kahlke, 2014, p. 43). The changing of the local environment into the mammoth steppe happened first in Southeastern and Central Europe before expanding further (Hosfield, 2020, p. 31). At this point the climate cycles still shifted between warmer and colder periods every 100.000 years but generally there was still a process of global cooling taking place. This maintained a general continuation of the mammoth steppe ecosystem, with regional variation, without reverting back to a climate in which the new fauna could not survive, but it still allowed for fauna adapted to warmer climates to endure as well and expand during the warmer cycles in which the cold steppe fauna was more restricted to northern latitudes (Kahlke, 2014, p. 39). The change towards this ecosystem is also noticeable at a couple of the inhabited sites in Central Eastern Europe such as Rusko 33 and 42 where the coniferous forests are replaced by grasses, creating a steppe or tundra landscape. A similar process takes place at Tunel Wielki and Schöningen where the environment transitions towards and open environment. This confirms that the colder and ongoing cooling was not a major problem for these hominins as they occupied Central Eastern Europe quickly after the glacial period of MIS 12.

The largest hurdle or drawback of the mammoth steppe, the cold climate, was thus deemed negligible when compared with the benefits. The big drive force behind this occupation and the general increase in occupation of Central Eastern Europe might be tightly connected with the new fauna which could serve as prey, generally increasing the available resources in the area. This new influx of resources could have allowed hominins to move away from refugia area in which they housed themselves in order to be protected from the climate or to obtain sufficient resources.

Figure 6.2 Modern day picture from Ukok Sailiugem in the Altai region. Argued by Ricankova et al. (2014) to be the best representation of how the Palaeolithic mammoth steppe would have looked. (www.Wikipedia.com).

Furthermore, the mammoth steppe is described as having a high animal density with most of the vegetation being grasses, herbs and shrubs (Zimov et al., 2012, p. 43). Combing these aspects, it means that average mobility of hominins on the hunt could have been reduced as opposed to hunting in closed forest. Consequently, this can limit the time hominins are exposed to the elements and lower the amount of effort required for a successful hunt. Zimov et al. (2012) goes even further as they argue that early hominins would always have big herbivores in eyesight and could survive on the mammoth steppe purely by scavenging due to the abundance and density of animals there, naturally a big change compared to hunting in boreal or deciduous forests pre.

6.5 - Aquatic resources

Aquatic resources are naturally limited to specific geographic features such as lakes, rivers and seas. This directly illustrates a difference between Northwestern Europe and Central Eastern Europe as the latter has much less access to the sea, only in the most norther fringes there is access, and generally has less extensive river and delta systems

which together bring about the continental climate discussed earlier. This division between the regions is relevant as the opportunity to exploit aquatic resources is not equal. Aquatic resources have been exploited by hominins long before they set foot in Northern Europe as proved by the Kenyan site FwJj20 in the Turkana Basin dating to 1.95 mya. At the site evidence for the consumption for turtles, crocodiles and fish has been found (Braun et al., 2010, p. 10002). Undoubtedly hominins in Europe would thus also have exploited aquatic resources given the opportunity. Generally speaking, aquatic resources are much more stable and reliable then terrestrial resources, especially when compared with hunting animals. This could have been an appealing benefit for early hominins in Europe and could very well have served as pull factor. Combine this knowledge with the increased variability in almost every aspect of their lives caused by the increased seasonality of the northern latitudes. Aquatic foods such as seaweeds and shellfish might have been a staple in the hominin winter diet, a luxury which is not available in the continental forest of Central Eastern Europe. The stability of these coastal zones is perhaps something that attracted prey animals as well meaning that if this is the case hunting could also have been easier, increasing the value of these coastal zones even more (Cohen et al., 2012, p. 71). Coastal zones are not the only landscapes which hold aquatic resources. River valleys and marshes can occur far inland and have the potential to boast similar resources. The aforesaid example is present at the Bisnik cave where a river valley and a marshy wetland are present (Cyrek et al., 2009, p. 26). Cohen et al. (2012) illustrate this nicely in the image below (see Fig. 6.3).

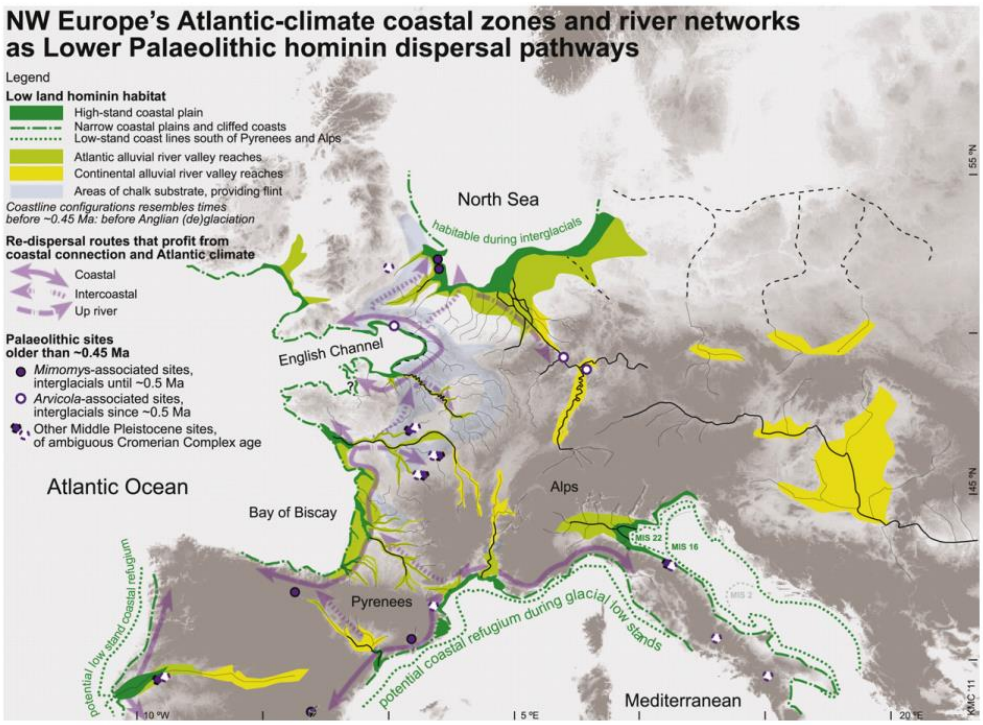

Figure 6.3 Map of Europe showing the European coastal zones and other fluvially affected areas. (Cohen et al., 2012, p. 79)

Immediately it becomes clear that the strong fluvial association with Northwestern Europe is not present in Central Eastern Europe. Even though there are great rivers in Central Eastern Europe such as the Elbe, the Oder and the Vistula seemingly there are only a couple of stretches where continental alluvial river valleys are present. While the coastal zones are obviously less present there are no arguments given as to why the aforementioned rivers are not considered to be attractive for hominins in the same way rivers in Northwestern Europe are. There are many possible explanations such as the instability of the rivers not allowing for a beneficial ecosystem or the lower temperatures and precipitation changing the fluvial landscape usefulness, but these are all speculations as long as no new research is present. While allegedly beneficial fluvial regions are missing in most of Central Eastern Europe, the area in which many sites discussed in chapter two can be found does seem to have these river valleys. These valleys likely served as a pull factor for this specific area signalling the importance aquatic resources might have had.

6.6 - Spatial resources

The interior landscape is a strong determining factor in where hominins live and where they move towards. The spatial distribution of resources also determines strategies and the success with which these strategies can be enacted is directly related with the liveability of a certain area.

The pull factor of the coastal and fluvial presence in Northwestern Europe could have been a welcome reassurance for the early hominins moving into Northern Europe. Likely these hominins did not have extensive knowledge of the terrain and local resources. Following rivers and coast lines might have offered the resource security they needed when venturing into new and unknown areas. They represent a visual marker of potential resources and the known landscape, subconsciously funnelling early hominins in a certain direction where there was more of the same (Hussain & Floss, 2016, p. 1180). Such circumstances then create a sort of highway through which hominins head into new areas and eventually spread out (Carrión et al., 2011, p. 1290). Combining this

theory with the climate findings presented earlier it does seem logical that early hominins moved into Northwestern Europe first as the similarities between Northwestern Europe and Southern Europe were at the time much more numerous than the similarities with Central Eastern Europe. Yet going somewhere first does not mean that these hominins stayed there exclusively, and it certainly does not clarify why there is such a large occupation gap.

Resource rich areas are only useful if you can obtain those resources successfully. So, choosing a suitable area to live in is important. An area in which high ecological differences are present often present ample opportunity for efficient resource gathering. Such areas are naturally found at the boundaries of different ecological zones which happens most often in hill and mountain country, a common terrain in Central Eastern Europe (Hopkinson, 2007, p. 300). When many zones converge in an area high biodiversity is generally present. This means that there is a high variety of resources easily accessible preventing the requirement of excessive effort and mobility in order to obtain a varied assemblage of resources (Hopkinson, 2007, p. 301). Variety in the landscape also brings with it a resilience against catastrophes and seasonal variation. If patches are close together, extinction due to a lack of diversity or dependence on a single resource, which may result from climate change for example, is less likely to happen (Hopkinson, 2007, p. 303). Lastly the mixture of available resources tends to reduce herd mobility as food is always close, a welcome benefit in winter times (Hosfield, 2020, p. 114).

6.7 – Relation of all the resources combined with the occupation gap

Combining all the information on the various types of resources discussed earlier we can see a couple of noteworthy things. First of all, raw material for stone tools it is present in both regions. Clearly the idea that flint and similar materials were not available in Central Eastern Europe is wrong, yet the ease with which it is obtainable differs in the regions as we have seen that in Northwestern Europe more natural sources can be found spanning much larger areas. No indications however can be found that early hominins had trouble finding raw material for stone tools in Central Europe. Schöningen and Tunel Wielki had plenty of raw material available at the site and the large assemblages from Trzebnica and Bilzingsleben seem to indicate that hominis could easily

acquire plenty of raw material for stone tools It does seem unlikely that the less widespread raw material sources were a major deterrent. Taking food resources, both aquatic and terrestrial, in account there is a clear difference. In terms of terrestrial food sources, it is mostly due to the impact of the climate that it can be assumed that obtaining this resource is more difficult and costly in Central Eastern Europe. This is however a generalization as circumstances are not homogenous throughout the research areas. While it thus might be though as a general rule there could very well be exceptions in certain areas. The same is partially true for aquatic resources. Marshes and river valleys can be found in both areas, but the big difference is the coastal zones in Northwestern Europe which no doubt would have been advantageous. Combine this with the spatial factors of a potential familiar Northwestern Europe and there is no doubt that overall Northwestern Europe provided more resources. It is only after MIS 12 that with certainty it can be said that in terms of food resources the playing field in the regions becomes equal with the introduction of the mammoth steppe. However, it is important to note that the mammoth steppe appeared earlier in Central Eastern Europe than in Northwestern Europe, which can be seen as a noteworthy reason for hominins to expand into Central Eastern Europe. The gap between occupation times can thus potentially be linked to easy and more widespread resources in Northwestern Europe and dispersed and isolated resources in Central Eastern Europe which was eventually negated by the mammoth steppe which allowed for a larger scale of occupation. As occupation becomes more common relatively quick after the end of the Elsterian and the introduction of the mammoth steppe the events seem to hint at a relation with the occupation gap.

Chapter 7 – The relation between hominin species with their behaviour and innovations and the possibilities of occupying Central Eastern Europe

In the earliest occupation of Northern Europe three hominin species played a key role. The first one on the stage is *Homo antecessor*. There is no evidence of this hominin venturing into Central Eastern Europe. Even evidence for their occupation in Northern Europe is scarce but is potentially present at Happisburgh in the form of footprints, but conclusive fossil evidence is lacking. Soon, as early 800 kya, *Homo antecessor* is replaced by *Homo heidelbergensis* (Hosfield & Cole, 2018, p. 150). While the direct evolutionary relation between these two hominins remains debated, it is clear that *Homo heidelbergensis* has a larger brain size than *Homo antecessor*, 1200 cc against 1000 cc respectively (Hosfield, 2020, p. 42). The oldest hominin fossils in Central Eastern Europe are those of *Homo heidelbergensis* found at Mauer. It thus begs the question what they had that allowed them to go into Central Eastern Europe. The current evidence seems to point towards similar occupation between Northwestern Europe and Central Eastern Europe happening only after MIS 11. Fossils from Bilzingsleben, dating to MIS 11, are attributed to *Homo heidelbergensis* or early *Homo neanderthalensis* (Haidle & Pawlik, 2010, p. 144). These fossils are much more centrally located in our research area and are thus the oldest most eastern fossils in our research area and timeframe. By this time Neanderthals were also present in Europe as the earliest evidence points towards 430 kya (Hosfield & Cole, 2018, p. 150). In an effort to understand whether a change in the dominant hominin species ended the occupation gap fossil evidence is important but as we can conclude fossil material is extremely rare making it difficult to ascertain which hominin lived where and when.

7.1 - Innovations in material and behaviour by new hominins

The more successful colonization of Europe by *Homo heidelbergensis* did not come out of nowhere. The skill of hide working for clothing, the construction of shelters and the use of fire are all ascribed to *Homo heidelbergensis*, resulting in these hominins being capable of living in the cold climate of Northern Europe (Ashton, 2015, p. 152). Yet not all of these innovations appear at the same time. Hide working for clothing is an essential skill needed to survive in any northern environment but is extremely difficult to identify in the archaeological record. Similarly, the use and construction of shelters is

very difficult to identify but allegedly already happened in the lower Palaeolithic (Chu, 2009, 350). These two innovations are thus not capable in explaining the gap as their existence is a reason for why there shouldn't be a gap. The use of fire however is however much younger with evidence being identified from around 400 kya. Fire use is an incredibly extensive topic on its own but some of the most important aspects related to the occupation of Central Eastern Europe are as follows: combating the cold climate and seasonality by having accesses to warmth and light and the ability to alter the landscape in a way to make it more favourable for hominins (MacDonald et al., 2021, p. 1). The latter is interesting, if hominin truly favoured a more open terrain as opposed to a forested terrain and did use fire to purposefully thin out the vegetation, as is suggested by Roebroeks et al. (2021), it is a potential indicator that the mammoth steppe played an even larger role in the eventual occupation of Central Eastern Europe as the open landscape would have been a natural pull factor.

Going hand in hand with the material innovations are changes in behaviour and life history. Generally speaking, the level of skill needed to survive in a more hostile climate such as the Northern European climate is much higher. More nuance in strategies and a higher dependency on very specific skills to survive bring about the need for transmitting these skills. Thus, the big change in behaviour that is suggested to be a key necessity in order to survive in highly seasonal climates of Europe is the ability to learn and teach skills, in short social learning (Ashton & Davis, 2021, p. 2). Combing the need for social learning with changes in the live history of *Homo heidelbergensis* likely led to the existence of the adolescent phase. It is argued that this phase in life caters towards the need for social learning in order to be a successful adult in later life (Hosfield & Cole, 2018, p. 150). A prime example of a practices that requires tremendous amounts of skill is hunting. Besides the skill of killing an animal it requires knowledge of the terrain and the behaviour of the animal, on top of this an understanding whether a prey is worth the effort in terms of overall calorie gain after the hunt is also necessary (Macdonald, 2007, 118).

The only way *Homo heidelbergensis* could evade adapting towards the climate of Northern Europe is through yearly mass migration back towards Southern Europe before the winter starts, nevertheless this is considered to be unlikely (Hosfield, 2020, p. 143). This general concept of *Homo heidelbergensis* successfully adapting to the cold climate of Europe brings us no further in uncovering a reason for the occupation gap, after all if *Homo heidelbergensis* was already suitably adapted to the cold climate as early as 800

kya an expansion into Central Eastern Europe is expected to have occurred much earlier than the archaeological record indicates.

7.2 - Hominin preferences

While the possibilities for an expansion into Central Eastern Europe were seemingly there in terms of technique and behaviour, for some reason it did not happen, potentially because hominin chose to not go there albeit consciously or by pure chance. Reasoning behind why the places which were occupied were occupied can be derived from both a combination of climate and resources but also from behaviour and choices. Looking at the mild climate and resources of the starting point from which hominins moved into Europe, namely Southern Europe, it seems that the coastal zones of Northwestern Europe are relatively similar both in terms of climate and resources. The implications are that the expansion and occupation of Northwestern Europe was facilitated by the similar circumstances and perhaps was more of a natural dispersion as hominins moved into more of the same habitual environment simply because that was the easiest direction into which to expand (MacDonald et al., 2012, p. 94).
Important to understanding how these hominis moved and expanded is whether there were major push and pull factors in play. If there were such factors the expansion and occupation of Northern Europe was potentially forced, meaning that it is more likely expansion happened beyond the boundaries of the similar environments. If these factors are not there it is much more likely that the expansion stayed within the similar habitual environment. So far unique pull factors have not been identified for Central Eastern Europe in the previous chapters. Furthermore, evidence for continuous occupation of Northern Europe is also lacking. Logical assumptions are thus that hominins retreated back towards the warmer climates of southern Europe during strong glacials such as during MIS 16 and 12 to return afterwards when the more favourable conditions returned (Ashton et al., 2018, p. 194). Suggested population size estimates for *Homo heidelbergensis* do not exist but they do for *Homo neanderthalensis* which indicate overall low population numbers ranging between 1000-5000 (Mafessoni & Prüfer, 2017, p. 10256). Hosfield (2020) argues along the same line and comes to a population density of 0.002/km2 for Europe during the lower Palaeolithic, which he calls and hominin empty landscape. While there is no conclusive evidence on whether these numbers are correct, these are seemingly in line with the idea that *Homo*

Heidelbergensis also had small population numbers and consequently a low population density. So, it can be stated that *Homo heidelbergensis* experienced little population pressure and thus was free to expand and remain largely in only the most optimal regions of Northern Europe, namely coastal Northwestern Europe and other smaller refuge areas such as potentially Southwestern Poland. Consequently, the lack of population pressure could result in more isolated population groups reducing the overall gene flow. In turn this is means that there is less selection, adaptation and overall innovation in the population which could have been another indirect reason for *Homo heidelbergensis* to not expand into Central Eastern Europe on a similar scale as they did in Northwestern Europe (Ashton & Davis, 2021, 15; Hosfield, 2020, p. 238). If it is true that *Homo heidelbergenis* mainly restricted itself to known and optimal environments whenever possible as MacDonald (2012) suggests, the occupation of Central Eastern Europe potentially had to wait till the occurrence of *Homo neanderthalensis*.

7.3 – The occurrence of *Homo neanderthalensis*

It is suggested that Neanderthals coped much better with a largely heterogeneous environment and when you combine this with the idea of resource patches as was outlined earlier, Neanderthals do seem a better fit for the environment of Central Eastern Europe (Hopkins, 2007, p. 304). The stocky build and facial morphology of Neanderthals is generally considered to be a bit more adapted and optimal for colder climates (Boyd & Silk, 2018, p. 301; Wroe et al., 2018, p. 7). While this might be helpful the consensus is that the physical adaptations were in no way substantial enough to forgo the use of other methods to keep warm such as fire, clothing and shelter (Key & Ashton, 2023, p. 21). The general consensus regarding the occurrence of *Homo neanderthalensis* is that they occur from MIS 11 onwards and it could thus mean that the increased brain size and the use of fire was the big difference between them and *Homo heidelbergensis* (Bahian et al., 2022, p. 1). At the same time during MIS 11 when Neanderthals start to appear, the climate heads into a long period of cooling and the mammoth steppe appears. Such an open climates seemed to have had the preference of Neanderthals opposed to dense forest as discussed earlier. This makes it troublesome to compare living circumstances between the two hominins as they differed quite a lot. Therefore, it is difficult to conclude whether Neanderthals could have lived in Central Eastern Europe at the time of the earliest occupation in Northwestern Europe.

7.4 – Conclusion on the hominin species and the occupation gap

The lack of fossil evidence makes it in general difficult to come to any hard conclusions. The introduction of Neanderthals cannot conclusively be attributed to them being successful in Central Eastern Europe due to *Homo heidelbergensis* lacking the skills to be successful on a similar level. Since the arrival of Neanderthals is so late in the occupation gap, their arrival coincides more with an overall change of the circumstances in Central Eastern Europe after the glacial of MIS 12, an opportunity which they could exploit better then *Homo heidelbergensis*. It might be this niche which allowed them to evolve and take over Europe as a species in the first place. Even if Neandertals arrived earlier in Northern Europe it remains doubtful whether they would not have adhered to the same occupation boundaries as heidelbergensis. The big technological advance of fire use seems to be the big difference between these species. While both species were around when fire was invented Neanderthals were on the rise while Heidelbergensis only declined from there. This brings us partly in a circle reasoning where fire use allowed Neanderthals to modify the environment more in line with the arising mammoth steppe, which allowed them to thrive in Central Eastern Europe making a comparison among the lines of living circumstances difficult. The only possible explanation for the occupation gap that can be derived from this is that Central Eastern Europe was not habitable for both hominin species and that the use of fire was the key aspect needed into occupying Central Eastern Europe on a grander scale, but naturally this neglects many other aspects of the grander discussion. This does beg the question whether *Homo heidelbergensis* could also have thrived in Central Eastern Europe had they had access to fire use and control before Neanderthals arrived on the scene. If we reason that fire was not needed to occupy Central Eastern Europe, the occupation gap can only be explained through homo heidelbergensis deciding to not occupy Central Eastern Europe as they simply did not have to as was outlined in the lack of population pressure argument. Note however that these two theories are not mutually exclusive and could both very well contribute to hominin factor in the existence the occupation gap.

Chapter 8 - Conclusion

The research question we set out to answer was as follows: Can it be concluded based on the evidence from sites in Central Eastern Europe that there is a gap between the first occupation in Northwestern Europe and Central Eastern Europe and if so what are the causes for this gap?

To adequately answer this, the question was split up into parts. First an occupation gap had to be identified and if it was present then potential causes could be indicated. This was done by the hand of the four hypotheses, climate, glaciation, resources and hominins, which were chosen based on preliminary research because those topics seemed to have the highest chance of delivering an answer.

Gathering data on the oldest sites in both Northwestern Europe and Central Eastern Europe has provided a clear answer to the first part of the question. With confidence it can be said that based on all the available archaeological data that there is indeed a gap between the first occupation in Northwestern Europe and Central Eastern Europe. While originally assumed that there were no sites older than 500 kya in Europe it has been proven that sites in Southern Europe can be dated to 1 mya. More importantly sites in Northwestern Europe can confidently be dated prior to 700 kya. After this date sites became more common there. Yet on the other hand in Central Eastern Europe sites do not reach this age. By creating an overview of the oldest sites in Central Eastern Europe we can conclude that there were no hominins occupying Central Eastern Europe prior to MIS 15 or taking the oldest date from Mauer, which is the oldest site in the region, prior to 621 kya. Sites overall are scarce in this region. Continuing with the overview there are only two other sites besides Mauer, namely Trzebnica and Tunel Wielki, which can be dated prior to MIS 12. All other sites discussed occur from MIS 11 onwards. It is from this timestamp that sites become a bit more common but as seen from table 3.1 in chapter three sites remain rare in Central Europe pre 300 kya. With this data there is only one conclusion that can be drawn which is that there unmistakably is a gap in the earliest occupation between the regions.

Identifying this gap allows for an attempt at answering the second part of the research question, what are the causes? First it is important to mention that the gap was not

caused by the destruction of the archaeological record due to land ice advances in various glacial cycles, an idea that was used in older studies to explain the lack of sites in Central Eastern Europe. The evidence of various sites in North Europe which predate one or multiple land ice expansion have proven that the gap is caused by hominin history.
While Central Eastern Europe certainly had to endure more ice sheet advances and was impacted heavier than Northwestern Europe two key points stand out. First the ice sheet advances never reached such an extent that the whole of Central Eastern Europe was covered and secondly while Northwestern Europe might have been free from land ice the glacial period still affected both regions meaning that they both experienced severe cooling phases. Combining this with the climate knowledge that in between the glacial cycles warm and milder periods took place it cannot be argued that the effects of the glacial cycles kept hominins out Central Eastern Europe especially during the interglacial stadia. It is not purely about continuous occupation when we define a region as occupied, this applies both to Northwestern Europe and Central Eastern Europe.

This variation is also reflected in the climate evidence. On the larger scale it becomes apparent that Central Eastern Europe has disadvantages in terms of the climate in almost all aspects. This is most strongly reflected in lower average temperatures but can also be seen in less precipitation but longer snow cover and the overall variation called seasonality. Broadly speaking, this can be attributed to the difference in the oceanic climate in Northwestern Europe and the continental climate in Central Eastern Europe. When zooming in however it is clear that the generalization stated before needs to be revised. Not in the sense that the general trend is wrong but that the image is deceiving as it lacks nuance. There are periods in which the general trend is broken when oceanic influence reaches far inland altering living circumstances in Northern Europe as whole, likely in favour of hominin habitation. Environmental reconstructions from Mauer, Trzebnica and Bilzingsleben confirm this image, Tunel Wielki potentially gives a similar reconstruction, but conclusive evidence is lacking. The sites are all described as temperate, mild and sometimes even Mediterranean. This certainly shows that the climate could not have been a major continuous obstacle for hominins as there were period in which the climate was favourable for large expansion into Central Eastern Europe. On the other hand, this means that the climate in Northwestern Europe must have been even more accessible. Following the general climate zone trend evidence

seems to suggest that no matter the situation the climate in Northwestern Europe has always been a bit more hospitable than the climate in Central Eastern Europe as there is no proof or any sort of suggestion that Central Eastern Europe has ever been more temperate and milder than Northwestern Europe.

In terms of resources, it is largely a similar story as with the climate circumstances. A variety of resources are available in Central Eastern Europe just as they are in Northwestern Europe, but they are harder to obtain as they are more isolated and less widespread. This is definitely true for raw material used for stone tools, yet large assemblages from Trzebnica and Bilzingsleben indicate that it was likely not as big of a problem. The big difference can be found in the aquatic resources. The coastal zones of Northwestern Europe are a major benefit and provided resource opportunities which are likely lacking in Central Eastern Europe. This causes hominin to be more dependent on the hunt which is troubled by certain climate factors. Naturally these climate factors also influence various fauna, making Central Eastern Europe potentially less liveable for them as well. So, the carrying capacity of regions in Central Eastern Europe based on resources is likely lower than in Northwestern Europe. The lesser carrying capacity results in the requirement for higher mobility which brings with it various negative effects by itself. It is only after MIS 12 with the introduction of the mammoth steppe that resource opportunities can be seen as equal between the regions. Even though the mammoth steppe does provide eventual equal resources it does not spread instantaneous throughout Europe. The short period in which only Central Eastern Europe has mammoth steppe resembles a unique period in time where Central Eastern Europe has a strong pull factor, potentially strong enough for hominins especially Neanderthals, to prefer Central Eastern Europe over Northwestern Europe. This difference in resources prior to MIS 11 is major and serves as an explanation as to why hominins refrained from moving into Central Eastern Europe.

Combining this with the knowledge gathered about hominins it does seem to be the most important factor. As said before the lack of hominin fossils prevents major conclusion to be drawn in this category. Yet if we humour the theory that *Homo heidelbergensis* experienced little to no population pressure in Europe it does allow us to create a possible understanding as to why the occupation gap existed and why it existed for such a long period of time.

Firstly, little population pressure means there is no need to expand into new areas. Secondly, the non-existence of unique pull factors in Central Eastern Europe, prior to the appearance of the mammoth steppe, that could outshine the overall better appeal of Northwestern Europe withheld hominins from general occupation of Central Eastern Europe.
Thirdly, the lack of major changes in most of *Homo heidelbergensis* existence until MIS 11 with the introduction of the mammoth steppe and the occurrence of *Homo neanderthalensis* maintained the absence of occupation in Central Europe.
These three key aspects reflect any plausible reason as to why there was an occupation gap the best.

With the research done up until this day I feel that it is not yet possible to explain the occupation gap fully. Future excavations in Central Eastern Europe can alter the timeline as it was presented here massively just as it had happened with the boundaries set in 1994. Furthermore, the argumentation lies partly on the lack of aquatic resources in Central Eastern Europe. Additional research focusing on the palaeolithic landscape of major rivers and their valleys, which is lacking now, could reveal important information on this topic. The numerous sites adjacent to the Rhine show this importance. Seeing how both Poland and Germany are home to rivers such as the Oder, Wisla, Weser and the Elbe future research here could prove fruitful. A better understanding of early hominin behaviour could also reveal more about what environment was considered favourable and thus why it would be logical for them to expand into certain areas or refrain from doing so. More research on the specific period of time where the mammoth steppe did occur in Central Eastern Europe but not yet in Northwestern Europe would be beneficial. Evidence of increased rapid occupation or evidence of migration into Central Eastern Europe could confirm that the mammoth steppe was a major pull factor and that the lack of prior resources was an important factor for the later occupation of Central Eastern Europe and thus the existence of the occupation gap.

Abstract

Originally the assumption was that Europe was only occupied after 500 kya. Discoveries of hominin Fossils in Southern Europe disproved this theory. Eventual findings in Northwestern Europe illustrated that the expanse of hominins in Europe had occurred earlier, namely between 1 mya and 700 kya, and took place on a larger extent that previously thought. The expansion of hominins however barely reached Central Eastern Europe with the oldest sites dating from around 600 kya. Yet these sites are extremely rare and the number of sites dating pre 350 kya can be counted on one hand, which is certainly not the case in Northwestern Europe. In order to explain this gap in occupation between the regions four potential factors used as smaller hypothesis have been identified. These hypotheses are centred around climate differences, glacial and land ice advancement variation, differences in resource availability and presence, and differences between hominin including their material innovations and behaviour. The identification of differences between Northwestern Europe and Central Eastern Europe is the main goal of this thesis and will be done by the hand of the previous mentioned categories. The results will be analysed so that the reasons behind the occupation gap can be explored. The research on the effects of glaciations and the ice sheet advances have proven that the occupation gap is real and is not caused by a destruction of the archaeological record due to land ice advances. A large-scale comparison between the two regions on climate and resources proves variation between the regions. The larger trends regarding the climate are subjected to local as well as periodic variation making it less likely to have been a continuous obstacle for occupation of Central Eastern Europe. Nonetheless the climate is generally considered to be more favourable for occupation in Northwestern Europe. The resource situation is deemed to be more telling and points towards resources being less available and more isolated in Central Eastern Europe. This reflects a constant state until MIS 11 with the introduction of the mammoth steppe. Lack of hominin fossils in the research area is problematic in forming an extensive analysis based on hominins. However estimated population numbers suggest little population pressure meaning there was less need to expand into new areas.
The analysis suggests that the variation in resources is the greatest causation of the occupation gap, especially the perceived lack of aquatic resource in Central Eastern Europe is important in this regard. Combining this with the idea that there was little

need to expand into less favourable areas makes it possible to formulate a reason along three main aspects as to why the occupation gap existed.

Reference List

Literature

Ashton, N., & Lewis, S. G. (2012). The environmental contexts of early human occupation of northwest Europe: The British Lower Palaeolithic record. *Quaternary International, 271,* 50-64.

Ashton, N., Lewis, S. G., De Groote, I., Duffy, S. M., Bates, M., Bates, R., Hoare, P., Lewis, M., Parfitt, S. A., Peglar, S., Williams, C. & Stringer, C. (2014). Hominin Footprints from Early Pleistocene Deposits at Happisburgh, UK. *PLoS ONE*, *9* , 1-13.

Ashton, N. (2015). Ecological niches, technological developments and physical adaptations of early humans in Europe: the handaxe-heidelbergensis hypothesis. In F. Coward (Ed.), *Settlement, society and cognition in human evolution: landscapes in the mind* (pp. 138-153). Cambridge University Press.

Ashton, N., Harris, C. R. E., & Lewis S. G. (2018). Frontiers and route-ways from Europe: the Early Middle Palaeolithic of Britain. *Journal of Quaternary Science, 33,* 194-211.

Ashton, N., & Davis, R. (2021). Cultural mosaics, social structure, and identity: The Acheulean threshold in Europe. *Journal of Human Evolution, 156,* 1-22.

Bahain, J. J., Mercier, N., Valladas, H., Falguères, C., Masaoudi, H., Joron, J. L., Froget, L., Moigne, A. M., Combier, J., & Moncel, M. H. (2022). Reappraisal of the chronology of Orgnac 3 Lower-to-Middle Paleolithic site (Ardèche, France), a regional key sequence for the Middle Pleistocene of southern France. *Journal of Human Evolution, 162,* 1-11.

Balter, M. (2001). In Search of the First Europeans. *Science, 291,* 1722-1725.

Berto, C., Nadachowski, A., Pereswiet-Soltan, A., Lemanik, A., & Kot, M. (2021). The Middle Pleistocene small mammals from the lower layers of Tunel Wielki Cave (Kraków-Częstochowa Upland): An Early Toringian assemblage in Poland. *Quaternary International, 577,* 52–70.

Bonhof, W. J., & van Kolfschoten, T. (2021). The metapodial hammers from the Lower Palaeolithic site of Schöningen 13 II-4 (Germany): The results of experimental research. *Journal of Archaeological Science: Reports, 35,* 1-13.

Bourguignon, L., Crochet, J. Y., Capdevila, R., Ivorra, J., Antoine, P. O., Agustí, J., Barsky, D., Blain, H. A., Boulbes, N., Bruxelles, L., Claude, J., Cochard, D., Filoux, A., Firmat, C., Lozano-Fernández, I., Magniez, P., Pelletier, M., Rios-Garaizar, J., Testu, A., & De Weyer, L. (2016). Bois-de-Riquet (Lézignan-la-Cèbe, Hérault): A late Early Pleistocene archeological occurrence in southern France. *Quaternary International, 393,* 24–40.

Boyd, R., & Silk, J. B. (2018). *How Humans Evolved*. W. W. Norton & Company

Braun, D. R., Harris, J., Levin, N. E., McCoy, J., Herries, A. I., Bamford, M. K., Bishop, L. C., Richmond, B. G., & Kibunjia, M. (2010). Early hominin diet included diverse terrestrial and aquatic animals 1.95 Ma in East Turkana, Kenya. *Proceedings of the National Academy of Sciences of the United States of America, 107,* 10002–10007.

Burdukiewicz, J. M. (2003). Lower Palaeolithic sites with small artefacts in Poland. In J. M. Burdukiewicz & A. Ronen (Eds.*), Lower Palaeolithic Small Tools in Europe and the Levant* (pp. 65-92). BAR International Series.

Burdukiewicz, J. M. (2021). The lower Palaeolithic assemblages in Central Europe in stratigraphic and palaeographic background. *L'anthropologie, 125,* 1-38.

Carbonell, E., Bermúdez de Castro, J. M., Arsuaga, J. L., Díez, J. C., Rosas, A., Cuenca-Bescós, G., Sala, R., Mosquera, M., & Rodriguez, X. P. (1995). Lower Pleistocene Hominids and Artifacts from Atapuerca-TD6 (Spain). *Science, 269,* 826–830.

Carrión, J. S., Rose, J., & Stringer, C. (2011). Early Human Evolution in the Western Palaearctic: Ecological Scenarios. *Quaternary Science Reviews, 30,* 1281-1295.

Chu, W. (2009). A functional approach to Paleolithic open-air habitation structures. *World Archaeology, 43,* 348-362.

Cohen, K. M., & Gibbard, P. L. (2019). 'Global chronostratigraphical correlation table for the last 2.7 million years' version 2022a. *Quaternary International, 500,* 20-31.

Cohen, K. M., MacDonald, K., Joordens, J. C., Roebroeks, W., & Gibbard P. L. (2012). The earliest occupation of north-west Europe: a coastal perspective. *Quaternary International, 271,* 70-83.

Cordain, L., Miller, J. B., Eaton, S. B., Mann, N., Holt, S. H. A., & Speth, J. D. (2000). Plant-animal subsistence ratios and macronutrient energy estimations in worldwide hunter-gatherer diets. *The American Journal of clinical nutrition, 71,* 682-692.

Cyrek, K., Socha, P., Stefaniak, K., Madeyska, T., Mirosław-Grabowska, J., Sudoł, M., & Czyżewski, U. (2010). Palaeolithic of Biśnik Cave (Southern Poland) within the environmental background. *Quaternary International, 220*, 5–30.

Despriée, J., Gageonnet, R., Voinchet, P., Bahain, J. J., Falguères, C., Varache, F., Courcimault, G., & Dolo, J. M. (2006). Une occupation humaine au Pléistocène inférieur sur la bordure nord du Massif central. *Comptes Rendus Palevol, 5,* 821–828.

Domanski, M., & Webb, J. A. (2000). Flaking properties, petrology and use of Polish flint. *Antiquity, 74,* 822-832.

Duke, C., & Steele, J. (2010). Geology and lithic procurement in Upper Palaeolithic Europe: a weights-of-evidence based GIS model of lithic resource potential. *Journal of Archaeological Science, 37,* 813-824.

Falguères, C., Bahain, J. J., Yokoyama, Y., Arsuaga, J. L., Bermudez de Castro, J. M., Carbonell, E., Bischoff, J. L., & Dolo, J. M. (1999). Earliest humans in Europe: the age of TD6 Gran Dolina, Atapuerca, Spain. *Journal of Human Evolution, 37,* 343–352.

Flatt, T., & Heyland, A. (2011). *Mechanisms of Life History Evolution : The Genetics and Physiology of Life History Traits and Trade-Offs.* Oxford University Press.

Foltyn, E., Foltyn, E. M., Jochemczyk, L., Nawrocki, J., Nita, M., Waga, J. M., & Wójcik, A. (2010). The oldest human traces north of the Carpathians (Kończyce Wielkie 4, Poland). *Journal of Archaeological Science, 37,* 1886-1897.

Garcia, J., Landeck, G., Martínez, K., & Carbonell, E. (2013). Hominin dispersals from the Jaramillo subchron in central and south-western Europe: Untermassfeld (Germany) and Vallparadís (Spain). *Quaternary international, 316,* 73-93.

García, N., & Arsuaga, J. L. (2010). The Sima de los Huesos (Burgos, northern Spain): palaeoenvironment and habitats of Homo heidelbergensis during the Middle Pleistocene. *Quaternary science reviews, 30,* 1413-1419.

Garcia, T., Féraud, G., Falguères, C., ; de Lumley, H., Perrenoud, C., & Lordkipanidze, D. (2010). Earliest human remains in Eurasia: New 40Ar/ 39Ar dating of the Dmanisi hominid-bearing levels, Georgia. *Quaternary geochronology, 5,* 443-451.

Gozhik, P., Lindner, L., & Marks, L. (2012). Late Early and early Middle Pleistocene limits of Scandinavian glaciations in Poland and Ukraine. *Quaternary International, 271,* 31-37.

Günther, A. W., Maul, L. C., Löscher, M., & Schreiber, D. (2011). Mauer – the type site of Homo heidelbergensis: paleoenvironment and age. *Quaternary Science Reviews, 30,* 1464-1473.

Haidle, M. N., & Pawlik, A. F. (2010). The earliest settlement of Germany: Is there anything out there? *Quaternary International, 223,* 143-153.

Hardy, K. (2018) Plant use in the Lower and Middle Palaeolithic: Food, medicine and raw materials. *Quaternary Science Reviews*, *191,* 393-405.

Hopkinson, T. (2007). The transition from the Lower to the Middle Palaeolithic in Europe and the incorporation of difference. *Antiquity, 81*, 294-307.

Hosfield, R. (2016). Walking in a Winter Wonderland? Strategies for Early and Middle Pleistocene Survival in Midlatitude Europe, *Current anthropology, 57,* 653-682.

Hosfield, R. (2020). *Earliest Europeans: A year in the life: Survival strategies in the lower Palaeolithic*. Oxbow Books

Hosfield, R., & Cole, J. (2018). Early hominins in north-west Europe: A punctuated long chronology? *Quaternary Science Reviews, 190,* 148-160.

Hussain, S. T., & Floss, H. (2016) Streams as Entanglement of Nature and Culture: European Upper Palaeolithic River Systems and Their Role as Features of Spatial Organizaiton, *Journal of archaeological method and theory, 23,* 1162-1218.

Kahlke, R., D. (2014). The origin of Eurasian Mammoth Faunas. *Quaternary Science Reviews, 96,* 32-49.

Key, A., & Ashton, N. (2023) Hominins likely occupied northern Europe before one million years ago. *Evolutionary Anthropology, 32,* 10-25.

Van, Kolfschoten, T. (2014). The Palaeolithic locality Schöningen (Germany): A review of the mammalian record. *Quaternary International, 326-327,* 469-480.

Van, Kolfschoten, T., Parfitt, S. A., Serangel, J., & Bello, S. M. (2018). Lower Paleolithic bone tools from the 'Spear Horizon' at Schöningen (Germany). *Journal of Human Evolution, 89,* 226-263.

Kot, M., Berto, C., Krajcarz, M. T., Moskal-del Hoyo, M., Gryczewska, N., Szymanek, M., Marciszak, A., Stefaniak, K., Zarzecka-Szubińska, K., Lipecki, G., Wertz, K., & Madeyska, T. (2022). Frontiers of the Lower Palaeolithic expansion in Europe: Tunel Wielki Cave (Poland). *Scientific Reports, 12,* 1-19.

Krajcarz, M. T., Bosák, P., Šlechta, S., Pruner, P., Komar, M., Dresler, J., & Madeyska, T. (2014). Sediments of Biśnik Cave (Poland): Lithology and stratigraphy of the Middle Palaeolithic site. *Quaternary International, 326–327,* 6–19.

Lang, J., Winsemann, J., Steinmetz, D., Polom, U., Pollok, L., Böhner, U., Serangeli, J., Brandes, C., Hampel, A., & Winghart, S. (2012). The Pleistocene of Schöningen,

Germany: a complex tunnel valley fill revealed from 3D subsurface modelling and shear wave seismics. *Quaternary Science Reviews, 39,* 86–105.

Lauer, T., & Weiss, M. (2018). Timing of the Saalian- and Elsterian glacial cycles and the implications for Middle - Pleistocene hominin presence in central Europe. *Scientific reports, 8,* 1-13.

MacDonald, K. (2007). Ecological Hypotheses for Human Brain Evolution: Evidence for Skill and Learning Processes in the Ethnographic Literature on Hunting. In W. Roebroeks (Ed.), *Guts and Brains An integrative Approach to the Hominin Record* (pp. 107-132). Leiden University Press.

MacDonald, K., Martinón-Torres, M., Dennell, R. W., & Bermúdez De Castro, J. M. (2012). Discontinuity in the record for hominin occupation in south-western Europe: Implications for occupation of the middle latitudes of Europe. *Quaternary International, 271,* 84–97.

MacDonald, K., Scherjon, F., Van Veen, E., Vaesen, K. K., & Roebroeks, W. (2021). Middle Pleistocene fire use: The first signal of widespread cultural diffusion in human evolution. *Proceedings of the National Academy of Sciences of the United States of America, 118,* 1-8.

Mafessoni, F., & Prüfer, K. (2017). Better support for a small effective population size of Neandertals and a long shared history of Neandertals and Denisovans. *PNAS, 114,* 10256-10257.

Mallick, R. (2000). *Entwicklung einer Mikrobeprobung zur Th/U-Datierung und Anwendung an quartären Travertinen aus dem Thüringer Becken*, Dissertation, University of Heidelberg.

Mania, D., & Vlček, E. (1981). Homo erectus in middle Europe: the discovery from Bilzingsleben. In B. A. Sigmon & J. S. Cybulski (Eds.), *Homo Erectus* (pp. 133-151). University of Toronto Press.

Metzger, M. J. (2018). *The Environmental Stratification of Europe, [dataset].* University of Edinburgh

Moine, O. (2014). Weichselian Upper Pleniglacial environmental variability in north-western Europe reconstructed from terrestrial mollusc faunas and its relationship with the presence/absence of human settlements. *Quaternary International, 337,* 90-113.

Moncel, M., Antoine, P., Hurel, A., & Bahain, J. J. (2021) Reassessment of the 'Abbevillien' in the perspective of new discoveries from the Lower Palaeolithic and Quaternary sites of Abbeville (Somme, northern France). *Journal of quaternary science, 36,* 1122-1136.

Moreno, D., Maïlys, R., Bahain, J., Duval, M., Falguères, C., Tissoux, H., & Voinchet, P. (2017). ESR dating of sedimentary quartz grains: some basic guidelines to ensure optimal sampling conditions. *Quaternaire, 28,* 161-166.

Muttoni, G., Scardia, G., Kent, D. V., Morsiani, E., Tremolada, F., Cremaschi, M., & Peretto, C. (2011). First dated human occupation of Italy at ~ 0.85 Ma during the late Early Pleistocene climate transition. *Earth and planetary science letters, 307,* 241-252.

Parés, J. M., & Pérez-González, A. (1995). Paleomagnetic Age for Hominid Fossilsat Atapuerca Archaeological Site, Spain. *Science, 269,* 830-832.

Parfitt, S. A., Ashton, N. M., Lewis, S. G., Abel, R. L., Coope, G. R., Field, M. H., Gale, R., Hoare, P. G., Larkin, N. R., Lewis, M. D., Karloukovski, V., Maher, B. A., Peglar, S. M., Preece, R. C., Whittaker, J. E., & Stringer, C. B. (2010). Early Pleistocene human occupation at the edge of the boreal zone in northwest Europe. *Nature, 466,* 229–233.

Parfitt, S. A., Barendregt, R. W., Breda, M., Candy, I., Collins, M. J., Coope, G. R., Durbidge, P., Field, M. H., Lee, J. R., Lister, A. M., Mutch, R., Penkman, K. E. H., Preece, R. C., Rose, J., Stringer, C. B., Symmons, R., Whittaker, J. E., Wymer, J. J., & Stuart, A. J. (2005). The earliest record of human activity in northern Europe. *Nature, 438,* 1008–1012.

Parfitt, S. A., Ashton, N. M., Lewis, S. G., Abel, R. L., Coope, G. R., Field, M. H., Gale, R., Hoare, P. G., Larkin, N. R., Lewis, M. D., Karloukovski, V., Maher, B. A., Peglar, S. M., Preece, R. C., Whittaker, J. E., & Stringer, C. B. (2010). Early Pleistocene human occupation at the edge of the boreal zone in northwest Europe. *Nature, 466,* 229–233.

Preece, R. C., & Parfitt, S. A. (2012). The Early and early Middle Pleistocene context of human occupation and lowland glaciation in Britain and northern Europe. *Quaternary International 271,* 6-28.

Renfrew, C., & Bahn, C. (2016). *Archaeology. Theories Methods and Practice*. Thames & Hudson.

Řičánková, V. P., Robovský, J., & Riegert, J. (2014). Ecological Structure of Recent and Last Glacial Mammalian Faunas in Northern Eurasia: The Case of Altai-Sayan Refugium. *PLOS ONE,* 9*,* 1-8.

Richter, D. & Krbetschek, M. (2015). The age of the lower Palaeolithic occupation at Schöningen. *Journal of Human Evolution, 89,* 46-56.

Roebroeks, W., MacDonald, K., Scherjon, F., Bakels, C., Kindler, L., Nikulina, A. V., Pop, E., & Gaudzinski-Windheuser, S. (2021). Landscape modification by Last Interglacial Neanderthals. *Science Advances, 7,* 1-13.

Rocca, R. (2016). First settlements in Central Europe: Between originality and banality. *Quaternary International, 409,* 213-221.

Rocca, R., Abruzzese, C., & Aureli, D. (2016). European Acheuleans: Critical perspectives from the East. *Quaternary International, 411,* 402-411.

Roebroeks, W., Conard N. J., & van Kolfschoten, T. (1992) Dense Forests, Cold Steppes, and the Palaeolithic Settlement of Northern Europe [and Comments and Replies]. *Current anthropology, 33,* 551-586.

Roebroeks, W. (2001). Hominid behaviour and the earliest occupation of Europe: an exploration. *Journal of human evolution, 4*1, 437-461.

Roebroeks, W. (2006). The human colonisation of Europe: where are we? *Journal of quaternary science, 21,* 425-435.

Roebroeks, W., & Van Kolfschoten, T. (1994). The earliest occupation of Europe: a short chronology. *Antiquity*, *68*, 489-503.

Salamon, T. (2015). Development of the topography-controlled Upper Odra ice lobe (Scandinavian Ice Sheet) in the fore-mountain area of southern Poland during the Saalian glaciation. *Quaternary Science Reviews, 123,* 1-15.

Schoch, W. H., Bigga, G., Böhner, U., Richter, P., & Terberger, T. (2015). New insights on the wooden weapons from the Paleolithic site of Schöningen. *Journal of Human Evolution, 89,* 214-225.

Shchelinsky, V. E. (2020). Large mammal hunting and use of aquatic food resources in the Early Palaeolithic (finds from Early Acheulean sites in the southern Azov Sea region). *Quaternary International, 541,* 182-188.

Socha, P. (2014). Rodent palaeofaunas from Bisnik Cave (Kraków-Czestochowa Upland, Poland): Palaeoecological, palaeoclimatic and biostratigraphic reconstruction. *Quaternary International, 326-327,* 64-81.

Speth, J. D. (2019). Neanderthals, vitamin C, and scurvy. *Quaternary international, 500,* 172-184.

Sudol-Procyk, M., Cyrek, K., Krajcarz, M., & Krajcarz M. T. (2016). Around the Bisnik cave – The area of human penetration during palaeolithic. *Anthropologie, 54,* 49-68.

Szymanek, M., & Julien, M. (2018). Early and Middle Pleistocene climate-environment conditions in Central Europe and the hominin settlement record. *Quaternary Science Reviews, 198,* 56-75.

Tourloukis, V. (2016). On the Spatio-Temporal Distribution of Mediterranean lower paleolithic sites: a geoarchaeological perspective. In K. Harvatti & M. Roksandic (Eds.), *Paleoanthropology of the Balkans and Anatolia: Human Evolution and its Context* (pp. 303-323). Springer.

Villa, P., & Lenoir, M. (2009). Hunting and Hunting Weapons of the Lower Palaeolithic of Europe. In J. Hublin & M. P. Richards (Eds.), *The Evolution of Hominin Diets : Integrating Approaches to the Study of Palaeolithic Subsistence* (pp. 59-87). Springer.

Wagner, G. A., Maul, L. C., Löscher, M., & Schreiber, H. D. (2011). Mauer – the type site of Homo heidelbergensis: palaeoenvironment and age. *Quaternary science reviews, 30,* 1464-1473.

Wisniewski, A., Badura, J. Salamon, T., & Lewandowski, J. (2014). The alleged Early Palaeolithic artefacts are in reality geofacts: a revision of the site of Konczyce Wielkie 4 in the Moravian Gate, South Poland. *Journal of Archaeological Science, 52,* 189-203.

Wroe, S., Walsh, W. R., Ledogar, J. A., Bourke, J. M., Evans, S. L., Fiorenza, L., Benazzi, S., Hublin, J., Stringer, C., Kullmer, O., Curry, M. P., Rae, T. C., & Yokley, T. R. (2018). Computer simulations show that Neanderthal facial morphology represents adaptation to cold and high energy demands, but not heavy biting. *Proceedings of The Royal Society B: Biological Sciences, 285,* 1-8.

Zimov, S. A., Zimov, N. S., Tikhonov, A. N., & Chapin III, F. S. (2012). Mammoth steppe: a high-productivity phenomenon. *Quaternary Science Reviews, 57,* 26-45.

Figures

Front page image The Mauer mandible. The oldest *Homo* fossil in Germany.
Photography by Schacherl, K. In:
Wagner, G., Krbetschek, M., Degering, D., Bahain, J., Shao, Q., Falguères, C., Voinchet, P., Dolo, J., Garcia, T., & Rightmire, G. P. (2010). Radiometric dating of the type-site for Homo heidelbergensis at Mauer, Germany. *Proceedings of the National Academy of Sciences, 107,* 19726–19730.

Figure 1.1 Map of Europe with sites indicated mentioned in this chapter. 1 Atapeurca-TD6, 2 Monte Poggiolo, 3 Pakefield, 4 Pont-de-Lavaud, 5 Happisburgh 3, 6 Bois de Riquet. Original map from Wikipedia edited by author.
https://commons.wikimedia.org/wiki/File:Blank_map_of_Europe_cropped.svg Accessed on 15-06-2023

Figure 2.1 Geology and sediment layers of Mauer with the location of the hominin mandible in the stratigraphy.
Wagner, G. A., Maul, L. C., Löscher, M., & Schreiber, H. D. (2011). Mauer – the type site of Homo heidelbergensis: palaeoenvironment and age. *Quaternary science reviews, 30,* 1464-1473.

Figure 2.2 Stratigraphy of Trzebnica 2 with a description.
Burdukiewicz, J. M. (2003). Lower Palaeolithic sites with small artefacts in Poland. In J. M. Burdukiewicz & A. Ronen (Eds.*), Lower Palaeolithic Small Tools in Europe and the Levant* (pp. 65-92). BAR International Series.

Figure 2.3 Various flint artifacts from Tunel Wielki Cave 1 & 2 are cores on flakes 3 & 4 Cores made on flint nodules.
Kot, M., Berto, C., Krajcarz, M. T., Moskal-del Hoyo, M., Gryczewska, N., Szymanek, M., Marciszak, A., Stefaniak, K., Zarzecka-Szubińska, K., Lipecki, G., Wertz, K., & Madeyska, T. (2022). Frontiers of the Lower Palaeolithic expansion in Europe: Tunel Wielki Cave (Poland). *Scientific Reports, 12,* 1-19.

Figure 2.4 Map of Europe with sites indicated mentioned in this chapter. 1 Mauer, 2 Trzebnica, 3 Tunel Wielki Cave, 4 Bilzingsleben, 5 Rusko 33 and 42, 6 Schöningen and 7 Bisnik Cave. Original map from Wikipedia edited by author. https://commons.wikimedia.org/wiki/File:Blank_map_of_Europe_cropped.svg Accessed on 15-06-2023

Figure 2.5 Reconstruction of four different stages and geography at Schöningen. The occupation discussed in the text is linked with stage B.
Lang, J., Winsemann, J., Steinmetz, D., Polom, U., Pollok, L., Böhner, U., Serangeli, J., Brandes, C., Hampel, A., & Winghart, S. (2012). The Pleistocene of Schöningen, Germany: a complex tunnel valley fill revealed from 3D subsurface modelling and shear wave seismics. *Quaternary Science Reviews, 39,* 86–105.

Figure 2.6 Four wooden spears from Schöningen.
Schoch, W. H., Bigga, G., Böhner, U., Richter, P., & Terberger, T. (2015). New insights on the wooden weapons from the Paleolithic site of Schöningen. *Journal of Human Evolution, 89,* 214-225.

Figure 2.7 Conclusive score for the lithic comparison illustrating the difference between the lithics.
Foltyn, E., Foltyn, E. M., Jochemczyk, L., Nawrocki, J., Nita, M., Waga, J. M., & Wójcik, A. (2010). The oldest human traces north of the Carpathians (Kończyce Wielkie 4, Poland). *Journal of Archaeological Science, 37,* 1886-1897.

Figure 4.1 Map of Europe divided into Environmental zones.
Metzger, M. J. (2018). *The Environmental Stratification of Europe, [dataset].* University of Edinburgh.

Figure 5.1 Maximum extent of the Sanian 1 ice sheet advance, indicated by the yellow line named S1.
Dumnicka, E., Galas, J., Najberek, K., & Urban, J. (2020). The influence of Pleistocene glaciations on the distribution of obligate aquatic subterranean invertebrate fauna in Poland. *Zoologischer Anzeiger, 286,* 90-99.

Figure 5.2 The maximum extent the land ice expansions during the MIS 12 Elsterian glaciation period.
Szymanek, M., & Julien, M. (2018). Early and Middle Pleistocene climate-environment conditions in Central Europe and the hominin settlement record. *Quaternary Science Reviews, 198,* 56-75.

Figure 5.3 Open cast mine housing the location of Rusko 42.
Burdukiewicz, J. M. (2021). The lower Palaeolithic assemblages in Central Europe in stratigraphic and palaeographic background. *L'anthropologie, 125*, 1-38.

Figure 6.1 Map of Europe show the likelihood of a lithic raw material source being present.
Duke, C., & Steele, J. (2010). Geology and lithic procurement in Upper Palaeolithic Europe: a weights-of-evidence based GIS model of lithic resource potential. *Journal of Archaeological Science, 37,* 813-824.

Figure 6.2 Modern day picture from Ukok Sailiugem in the Altai region. Argued by Ricankova, V. P., Robovsky, J., & Riegert, J. (2014) to be the best representation of how the Palaeolithic mammoth steppe would have looked.
https://en.wikipedia.org/wiki/Mammoth_steppe#/media/File:Ukok_Plateau.jpg accessed on 05-06-2023.

Figure 6.3 Map of Europe showing the European coastal zones and other fluvially affected areas.
Cohen, K. M., MacDonald, K., Joordens, J. C., Roebroeks, W., & Gibbard P. L. (2012). The earliest occupation of north-west Europe: a coastal perspective. *Quaternary International, 271,* 70-83.

Tables

Table 3.1 All discussed sites put together in a rough overview to illustrate the pattern of the oldest occupation in its respective regions. Created by the author.