More on the Magdalenian in Thuringia – A re-investigation of the faunal remains from Teufelsbrücke

Mehr vom Magdalénien aus Thüringen - Eine Neubearbeitung der Faunenreste aus der Teufelsbrücke

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Abstract - The animal bones from the 1970 to 1972 excavation at Teufelsbrücke (Thuringia) have been re-analysed and ten new radiocarbon dates were obtained. These dates, in combination with data from lithic tools, indicate a c. 16,000-15,000 calBP old occupation by Upper Magdalenian humans in the late Greenland-Stadial 2.1a. The faunal assemblage turned out to be seven times more numerous than had been reported in its first publication. It is heavily dominated by horse, with still many remains from reindeer, arctic hare, fox and ptarmigan, beside only few remains from a large bovid, from mammoth, brown bear, wolf/dog, wolverine, common raven and whooper swan. Remarkable is the presence of ibex, woolly rhinoceros, marmot, lynx and cave lion. Presence of leopard and saiga antelope, which were described from Teufelsbrücke in an earlier study, could not be confirmed. The horse remains represent a 'standard' Minimum Number of Individuals (MNI) of 66 horses, yet an extended MNI of 200 horses is more plausible. The skeletal elements attest that all body parts were introduced to the Teufelsbrücke. Horse hunting was performed during summer and into late autumn, with a random selection of animals from all age groups. Very young animals confirm that family groups were certainly targeted. Numerous pendants from a variety of animal species were found in addition to those already described in a previous publication. Cutmarks on horse and reindeer phalanges is indirect proof for the use of horn. The final discussion uses the model of Magdalenian lifeways from Leesch et al. (2019) to show that Upper Magdalenian humans used Teufelsbrücke immediately after a successful hunting event on large herbivores close by. They stayed there briefly, yet repeatedly, for the consumption of hunted animals and related domestic activities, and for hunting the small game in the vicinity. Based on the number of horses alone, one has to expect at the very least 60 re-occupations of the site, but a number of 200 stays seems more plausible.

Zusammenfassung - *Die Tierknochen der Ausgrabung von 1970 bis 1972 in der Teufelsbrücke wurden erneut untersucht und zehn neue ^{14}C-Daten erstellt. Die neuen Daten, zusammen mit den Steingeräten, belegen eine etwa 16.000-15.000 Jahre alte Begehung durch die Menschen des Spätmagdaléniens im späten Grönland-Stadial 2.1a. Im Gegensatz zur Erstpublikation erwies sich das Fauneninventar der Teufelsbrücke als etwa siebenmal so reichhaltig wie bisher bekannt. Die Reste vom Pferd dominieren stark, gefolgt von häufigen Resten von Rentier, Schneehase, Fuchs und Schneehuhn. Nur wenige Stücke belegen eine große Rinderart, Mammut, Braunbär, Wolf/Hund, Vielfraß, Kolkrabe und Singschwan. Bemerkenswert ist der Nachweis von Steinbock, Wollnashorn, Murmeltier, Luchs und Höhlenlöwe. Das in einer früheren Arbeit beschriebene Vorkommen von Leopard und Saiga-Antilope ließ sich nicht bestätigen. Das Pferd ist mit einer 'Standard'-Mindestindividuenzahl (MIZ) von 66 Tieren vertreten, doch dürfte eine erweiterte MIZ von knapp 200 Pferden realistischer sein. Die vorhandenen Skelettelemente belegen, dass alle Körperteile in die Teufelsbrücke eingebracht worden sind. Pferdejagd erfolgte im Sommer und bis in den späten Herbst, mit der zufälligen Auswahl von Tieren aller Altersgruppen. Sehr junge Tiere belegen die Jagd auf Familiengruppen. Zahlreiche Anhänger aus einer Vielzahl unterschiedlicher, organischer Materialien wurden neu gefunden, zusätzlich zu den bereits publizierten. Die Nutzung von Horn ist indirekt durch Schnittspuren auf den Hufgliedern von Pferd und Rentier belegt. Die Abschlussdiskussion der Ergebnisse wird mit dem Modell von Leesch et al. (2019) zum Leben der Menschen im Spätmagdalénien durchgeführt. Es wird gezeigt, dass die Teufelsbrücke immer nach einer erfolgreichen Jagd auf die grossen Herbivoren in direkter Nähe begangen wurde. Die Aufenthalte waren kurz, aber vielfach wiederkehrend, und dienten dem Konsum der Jagdbeute und damit zusammenhängenden, alltäglichen Aktivitäten, währenddessen die kleineren Tiere in der Umgebung gejagt wurden. Aufgrund der Anzahl der nachgewiesenen Pferdeindividuen kann davon ausgegangen werden, dass es mindestens 60 Begehungen gab, doch scheint eine Anzahl von 200 Begehungen eher plausibel.*

Keywords - archaeozoology, chronostratigraphy, Late Weichselian, Central Germany, horse, hunting, mobility
Archäozoologie, Chronostratigraphie, Spätweichsel, Mitteldeutschland, Pferd, Jagd, Mobilität

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"the character of living beings (organs and types of behaviour), (…) one can never stop translate them, re-translate them differently, doing justice to their intimate otherness, to their compacted historicity"
(Morizot 2022: 41-42).

Introduction

The Teufelsbrücke (English: devil´s bridge, Federal State of Thuringia, Germany) is a 12 x 8 m large chamber in a calcareous rock formation. The thin roof collapsed in the front and back of the chamber, forming a small, bridge-like rock roof with an opening to the south. It is situated at the upper edge of a narrow spur, the Gleitsch, which is connected to a wide, 400 m high plateau, immediately above the river Saale which runs through a narrow valley 185 m below the site (Fig. 1). The excavation of the Teufelsbrücke was started by local amateurs in the 1960s (Waniczek & Lange 2001). After the discovery of palaeolithic artefacts, Rudolf Feustel from the Archaeological Museum of Thuringia continued the fieldwork from 1970 to 1972 to excavate 120 m² during 13 weeks (Feustel 1970, 1980a; Walter 1985: 51-52). The sediments were for the most part dry-sieved, with some samples wet-sieved with small mesh sizes to check that no significant number of remains were overlooked (Feustel 1980a). From this campaign more than 25,000 lithic artefacts, c. 400 bone artefacts and more than 200 rocks are published (Feustel 1980a) as well as few remains from the Bronze and Iron Age and later periods (Walter 1985: 51-53). The faunal remains were investigated by Gottfried Böhme, Dietrich von Knorre and Rudolf Musil (Feustel 1980b). It is important to note that no spatial data is available for the excavated objects as their recording was restricted to their lithostratigraphic position only. Later, re-investigations of Teufelsbrücke were done of the engravings on rocks (Wüst 1998), on ^{14}C dates (Küßner 2009: 232-233), on the organic projectiles (Pfeifer 2015) and on a lithic assemblage stored at the museum of Saalfeld (Bock et al. 2017). A re-analysis of the faunal remains seemed warranted as the Teufelsbrücke is one of only eight sites in Central Germany where many stratified and well-dated, Late Weichselian animal bones are preserved (see chapter Discussion). The results of this investigation are presented in this article.

Sediments and preservation of faunal material

As described by Feustel (1980a: 9-13), the stratigraphy of the rock shelter-like Teufelsbrücke is characterized by 1 m thick Pleistocene, scree-like sediments (with layer 4 on top, followed by layers 3 and 2, which were situated above the lower most layer 1). These layers were covered by a thick humic layer that contained lithic artefacts as well as pre-roman and medieval remains. It is questionable whether layers 1-4 represent four stratigraphic units in superposition: the sediments of the site are characterized by a strong inclination of the layers towards the steep slope, by presence of sedimentation gaps, by only slight petrographic differences between layers but by distinct facial and lateral characteristics (Feustel 1980a: 10) which are signs of diverse periglacial processes that influenced the local landscape

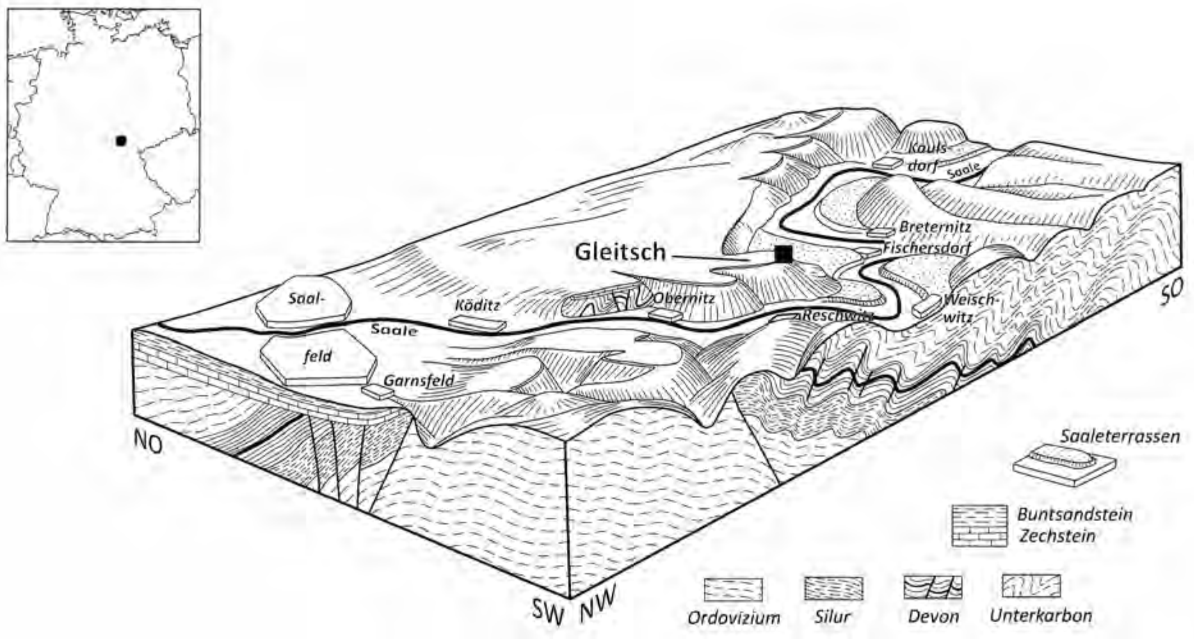

Fig. 1. Landscape morphology and geology of a part of the upper Saale valley with Teufelsbrücke (square) – adapted from Wagenbreth & Steiner 1990: 123, published in Bock et al. 2017.
Abb. 1. *Landschaft und Geologie eines Ausschnitts aus dem Oberen Saaletal mit Teufelsbrücke (Quadrat) – Grundlage: Wagenbreth & Steiner 1990: 123, publiziert in Bock et al. 2017.*

development in the Pleistocene (Schilling & Wiefel 1962: 446-450). Besides, the stratigraphy of the Teufelsbrücke was massively disturbed by iron mining and smelting, by quarrying, modern infill of sediments and rocks, as well as by illegal excavations and animal burrows (Auerbach 1930: 270; Feustel 1980a; Walter 1985: 53). Thus, a quarter of the published artefacts derive from a disturbed context (Feustel 1980a: 9). Furthermore, postglacial microfauna and molluscs, recent charcoal and Holocene animal remains occur among the 1970-72 assemblage (Feustel 1980a: 12, 1980b: 60; Maul 2002: 198). Hence, the presence of bones of ermine, polecat, badger and roe deer as well as many bird species are not seen as belonging to the Palaeolithic assemblage (Bock et al. 2017: 12). As there are no stratigraphic differences in lithic tool types and animal species, the excavator (Feustel 1980a: 46 & 116; Feustel 1980b: Tab. 1) did not expand on time depth of the Magdalenian assemblage (see also: Wüst 1998: 99). This view is supported by the investigation presented here: in general, preservation of bones from Teufelsbrücke is good but varies between layers, yet also among layers. Some remains have a very dark outer surface with some white marbling, and a solidified appearance. When broken, the inner part is almost white, as can be seen at the ulna of an ibex where a sample for radiocarbon dating had been taken (Fig. 2). However, remains with this appearance can be found in all layers. The largest part of the bone assemblage is lighter coloured, more or less degraded or bleached and bears sometimes extensive traces of plant roots (Fig. 3). These kind of remains can also be found in all layers. As already Musil stated (Feustel 1980b: 5), the different colour and appearance of the remains cannot be a chronological indicator. In our view this is due to facial and lateral differences of the sediments as well as recent disturbances. However, it is a long-established fact in Palaeolithic archaeology that without refitting of lithics and animal bones no review of lithostratigraphic units and no reliable interpretation of site formation processes is possible (e.g. Villa 1982; Lauxmann & Scheer 1986; Hahn 1988; Bordes 2003; Morin et al. 2005; Staurset & Coulson 2014). Unfortunately, for Teufelsbrücke the large number of bones, unknown before work began (see chapter Material and methods), prevented the intended refitting of bone fragments for stratigraphic verification.

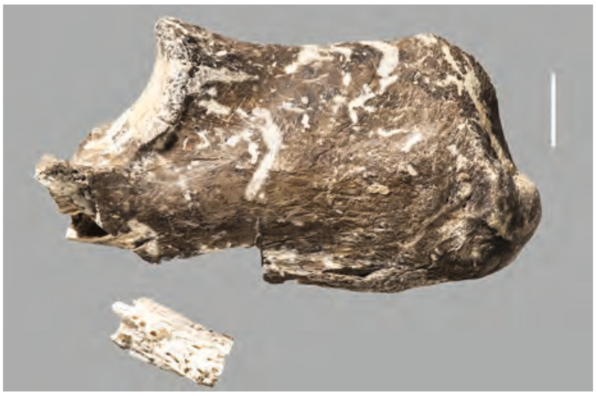

Fig. 2. *Capra ibex* from Teufelsbrücke – Proximal part of an ulna showing the dark outer surface with white marbeling. At the bottom the sample cut out for radiocarbon dating shows the white inner bone. Scale bar = 1 cm (photo: W. Müller).
Abb. 2. *Capra ibex aus der Teufelsbrücke – Proximaler Teil einer Ulna mit dunkler, weißlich marmorierter Außenseite. Die unten liegende, zur ^{14}C-Datierung ausgeschnittene Probe zeigt das weiße Innere. Maßstab = 1 cm (Foto: W. Müller).*

Fig. 3. *Equus ferus* from Teufelsbrücke – Metacarpal bone with traces of plant roots, while otherwise very good preservation of the surface. Scale bar = 1 cm (photo: W. Müller).
Abb. 3. *Equus ferus aus der Teufelsbrücke – Metacarpus mit Wurzelfraß, ansonsten aber gut erhaltener Oberfläche. Maßstab = 1 cm (Foto: W. Müller).*

Chronostratigraphy

The chronostratigraphic position of Teufelsbrücke is based on 20 radiocarbon dates which were obtained in the 1970s (Tab. 1: 10, 16, 18 & 19), 1990s (Tab. 1: 9, 12-15 & 20) and the present study (Tab. 1: 1-8, 11 & 17). According to the advice of the radiocarbon laboratory at Mannheim the $\delta^{13}C$ value is not to be used for interpretation of the radiocarbon measurement (written information, S. Lindauer & R. Friedrich, 8/25/2022). For the present study, ten new radiocarbon dates were obtained for different species from the different layers. Eight dates indicate the time period between c. 16.2 and c. 15.3 ka calBP (Fig. 4), well in accordance with the archaeostratigraphic position mentioned by Bock et al. (2017). It should be noted that a distribution of radiocarbon dates over a period of 900 years does not imply human presence over a millennium. As shown by the Upper Magdalenian sites Champréveyres and Monruz, where well preserved living floors are the result of successive human stays over a short time span, their radiocarbon dates spread over more than six centuries as well (Leesch 1997: Fig. 13). Two dates of the

Sample-no.	Lab-no.	^{14}C-years BP	2σ calBP	Material	Layer	δ ^{18}O episode
1	MAMS 55158	14,020 ± 35	17,318-16,953	*Alopex lagopus*, mandibula	1	GS-2.1b, GS-2.1a
2	MAMS 55156	13,350 ± 33	16,218-15,911	*Mammuthus primigenius*, molar	3	GS-2.1a
3	MAMS 55159	13,330 ± 35	16,190-15,866	*Capra ibex*, radius (cut marks)	1	GS-2.1a
4	MAMS 55164	13,310 ± 34	16,165-15,844	*Capra ibex*, ulna (cut marks)	4/3a	GS-2.1a
5	MAMS 55163	13,250 ± 35	16,053-15,763	*Rangifer tarandus*, metacarpus (cut mark)	4/3a	GS-2.1a
6	MAMS 55160	13,140 ± 34	15,922-15,636	*Equus ferus*, tibia (cut marks)	1	GS-2.1a
7	MAMS 55161	13,130 ± 35	15,910-15,624	*Equus ferus*, incisivus (cut marks)	3	GS-2.1a
8	MAMS 55155	13,100 ± 34	15,850-15,575	cf. *Bison priscus*, phalanx (cut marks)	02. Jan	GS-2.1a
9	OxA-5723	13,080 ± 140	16,084-15,248	*Capra ibex*, calcaneus (cut marks)	2	GS-2.1a
10	Bln 1573	13,025 ± 85	15,880-15,283	bulk sample of animal bones	3	GS-2.1a
11	MAMS 55157	12,970 ± 34	15,675-15,339	*Coelodonta antiquitatis*, phalanx (cut marks)	4	GS-2.1a
12	OxA-5724	12,940 ± 140	15,930-15,091	artiodactyl, radius (cut marks)	2	GS-2.1a
13	OxA-5725	12,900 ± 130	15,855-15,052	*Capra ibex*, tibia (cut marks)	1	GS-2.1a
14	OxA-5722	12,860 ± 130	15,810-14,950	*Equus ferus*, phalanx (cut marks)	2	GS-2.1a
15	OxA-5726	12,640 ± 130	15,391-14,278	*Rangifer tarandus*, humerus (cut marks)	3	GS-2.1a, GI-1e
16	Bln 1727	12,480 ± 90	15,085-14,218	bulk sample of bones	4	GS-2.1a, GI-1e
17	MAMS 55162	12,470 ± 33	14,971-14,355	*Equus ferus*, phalanx (cut marks)	4/3a	GS-2.1a, GI-1e
18	Bln 1924	12,315 ± 100	14,870-13,989	collagen of Bln 1821	3	GS-2.1a, GI-1e, GI-1d
19	Bln 1821	12,300 ± 85	14,759-13,995	bulk sample of animal bones	3	GS-2.1a, GI-1e, GI-1d
20	OxA-5727	10,040 ± 120	12,013-11,239	*Equus ferus*, mandible (cut marks)	3	GS-1, Preboreal

Tab. 1. Radiocarbon data from the Teufelsbrücke. Dates from sample-no. 9, 10, 12-16, 18-20 from Bock et al. (2017), from sample-no. 1-8, 11 and 17 from this study, calibration with OxCal v3.10 (Reimer et al. 2009), Greenland ice core climatostratigraphy by Rasmussen et al. (2014). Bones of sample-no. 9 and 13 were determined by Street (in Housley et al. 1997) as ´ibex? ´: species determination has now been confirmed in the present study, thus the question mark is removed.

Tab. 1. *^{14}C-Daten der Teufelsbrücke. Die Daten der Proben Nr. 9, 10, 12-16, 18-20 aus Bock et al. (2017), aus Proben Nr. 1-8, 11 und 17 aus dieser Studie, Kalibrierung mit OxCal v3.10 (Reimer et al. 2009), Klimatostratigraphie der grönländischen Eiskerne von Rasmussen et al. (2014). Die Knochen der Proben Nr. 9 und 13 wurden von Street (in Housley et al. 1997) als 'Steinbock?' bestimmt: Die Artbestimmung wurde nun in der vorliegenden Studie bestätigt, daher wurde das Fragezeichen entfernt.*

Teufelsbrücke do not fall into the range of the Upper Magdalenian in Central Germany (Tab. 1: 1 & 20) and will be discussed below. It has to be emphasized that the eight dates from layer 1 to layer 4 overlap. Thus, the new radiocarbon dates support the interpretation (see chapter Sediments and preservation of faunal remains) that the layers defined during the 1970-72 excavation do not represent a stratigraphic succession but are sedimentary facies with diverse preservation conditions.

When comparing the ten new radiocarbon dates with the ten former dates, a group of thirteen samples range between c. 16.2-15.0 ka calBP (Tab. 1: 2-14) and thus support the attribution to the local Upper Magdalenian (Bock et al. 2017; Maier et al. 2020: 36; Pasda & Weiß 2020: 68). Again, no age differences between the layers are discernible. However, few radiocarbon dates are a little bit younger (Tab. 1: 16-20). These will be discussed now.

Among samples 2-15 are radiocarbon dated reindeer, horse, bison and ibex which characterize the tree-less, cold-climate landscape of Central Germany in the later part of Greenland-Stadial 2.1a (Pasda & Pfeifer 2019). Proven by radiocarbon dated remains, now for the first time for Central Germany, the presence of mammoth and woolly rhinoceros is indicated in that time period as well (Tab. 1: 2 & 11). These two animal species may also be depicted on portable art of Teufelsbrücke and neighbouring Kniegrotte but remain difficult to be identified with certainty on the engravings (Feustel 1974: 112; Bosinski 1982: 43; Wüst 1998: 112 & 116-117). Nevertheless, these two radiocarbon-dated animal species contribute to the discussion of changes in megafauna in the Late Pleistocene (Cupillard et al. 2015; Stuart 2015; Baca et al. 2017) but may need reconsideration by more radiocarbon dated samples.

Reindeer disappeared in France, Western and Central Germany between c. 15-14 ka calBP (Sommer et al. 2014: 302-303; Costamagno et al. 2016; Pasda & Pfeifer 2019: 470). Sample 15 of Teufelsbrücke (Tab. 1) is another indicator of the latest reindeer in Central Germany. However, the fluctuations of the atmospheric carbon cycle with the onset of warmer climate in Greenland-Interstadial 1e (see references in Pasda & Pfeifer 2019: 470) influence precise dating of this sample. The same may be true for sample 17 (Tab. 1), a horse bone with cut marks. It is difficult to decide if this remain is an imprecisely dated part of the local Upper Magdalenian which ended c. 15 ka calBP or if it is evidence of the Hamburgian which occurs in Northern Germany during that time period (Grimm et al. 2021: 440). No lithic evidence of the Hamburgian is present at Teufelsbrücke as the determination of Feustel (1980a: 51) – he mentions a fragment of a shouldered point and three backed points – cannot be supported here. The same can be said of the supposed shouldered points from neighbouring sites Kniegrotte and Urdhöhle (Höck 2000: 92; Terberger et al. 2003: 7). Thus, the nearest evidence of a Hamburgian-like site is the assemblage of Etzdorf, a surface collection c. 40 km northeast of the Teufelsbrücke (Bergmann et al. 2011).

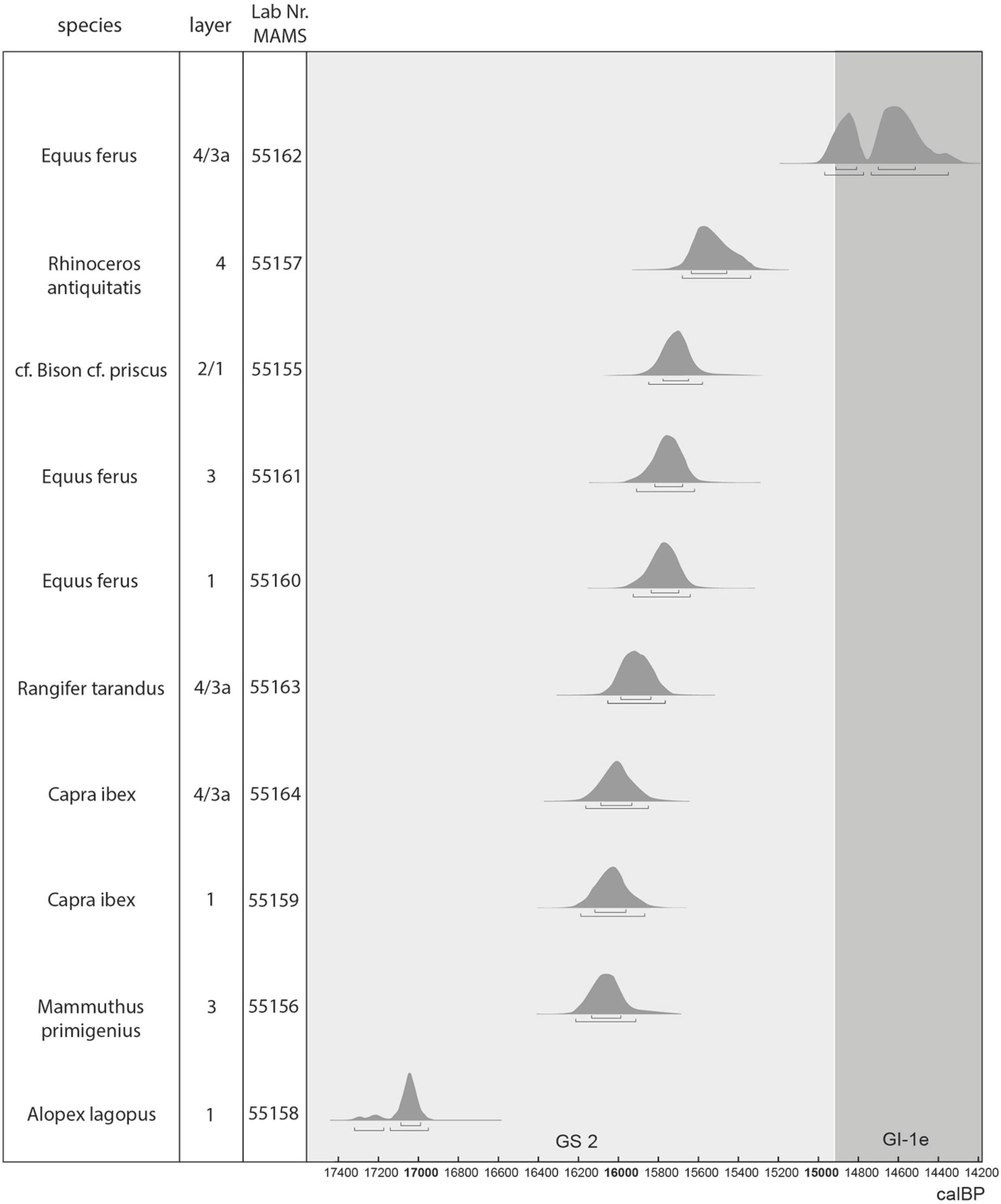

Fig. 4. Ten new radiocarbon dates (in yrs calBP) from Teufelsbrücke (graphic: W. Müller).
Abb. 4. *Zehn neue ^{14}C-Daten (in yrs calBP) aus der Teufelsbrücke (Grafik: W. Müller).*

Samples 16, 18 and 19 (Tab. 1) are three of the four bulk samples of animal bones, which were radiocarbon dated in the 1970s and are much younger than the Upper Magdalenian in Central Germany. These samples may represent a mixture of bones of different ages (Pettitt et al. 2003: 1686) and should not be considered for discussing the chronostratigraphic position of the Teufelsbrücke. This view is supported by the fact that at Teufelsbrücke the presence of Final Palaeolithic/Azilian artefacts, which appear in Central Germany at c. 14.2 ka calBP (Pasda & Pfeifer 2019: 470-472), can be ruled out with certainty (Bock et al. 2017: 13). This makes the youngest sample from Teufelsbrücke, a horse bone with cut marks from the Pleistocene/Holocene border (Tab. 1: 20), the more mysterious as the nearest evidence of the Ahrensburgian is present more than 100 km to the north (Ansorg 2020; Winkler 2020). However, in Central Germany horse is a common faunal component of Greenland-Stadial 1 and the early Holocene as indicated by radiocarbon dated bone samples from other sites (Pasda & Pfeifer 2019: 472).

Another radiocarbon date of Teufelsbrücke does not correlate with the Upper Magdalenian, an arctic fox that lived c. 1,000 years before the human occupation (Tab. 1: 1). Because no human-made cut marks are present it should be considered part of an older background fauna. However, the discussion of the archaeo- and chronostratigraphic position of the spear-thrower, some projectile points and a half-round rod from Teufelsbrücke (Feustel 1980a: 35-37) may indicate that few older artefacts of Magdalenian people occur at this site (Cattelain 2020; Maier et al. 2020; Pétillon & Cattelain 2022).

In sum, the majority of radiocarbon dates of Teufelsbrücke indicate presence of a c. 16-15 ka calBP old Upper Magdalenian of the tree-less steppe/tundra of Greenland-Stadial 2.1 a. One sample indicates use of the Teufelsbrücke by a small carnivore 1,000 years before the Upper Magdalenian. Few samples are a bit younger than the Upper Magdalenian but may be results of imprecise dating methods. Only one date is open for speculation whether it indicates a brief stay of humans during Greenland-Stadial 1.

Archaeozoology

Material and methods

The faunal remains presented here were excavated by Rudolf Feustel in 1970-72 and investigated by renowned palaeontologist Rudolf Musil (1926-2022) from Masaryk University of Brno (Czech Republic). His results were published in 1980 (Feustel 1980b: 5-59). In this study Musil presents bones determinable according to species and skeletal element layer by layer but his main focus was on osteometry and morphology of the horse remains. The publication seemed to indicate that Rudolf Musil had the entire fauna available. He gives the number of animal remains for individual layers or layer packets, which adds up to 2,097 remains (Feustel 1980b: 6-14). Among them are 1,687 bones and teeth that had been assigned to only a single stratum (Feustel 1980b: 14). The selection of the horse teeth for his morphological and morphometrical study - he used only jugulars, i.e. premolars and molars (Feustel 1980b: 20-24 & Tab. 3-10) - can no longer be clearly reconstructed. Musil stated that he only used teeth from the brown layer 4. In a table (Feustel 1980b: 17) he gives the number of teeth that are "undivided" compared to those that he considers "divided", i.e. intentionally broken longitudinally or transversely. For layer 3 he mentions 118 teeth (45 divided, 73 undivided), and from layer 4 he mentions 277 teeth (124 divided and 153 undivided), so a total of 405 teeth. In the tables with the morphometric data (all from layer 4) he lists 105 teeth from the upper jaw and 195 from the lower jaw, i.e. a total of 300 and not 277. The reason for this discrepancy must remain open. Among the bone material studied here are the teeth that Musil apparently examined and numbered in pencil. These amount to 181 upper and 300 lower molars. It is no longer clear why these do not all appear in the tables, which teeth Musil actually used, and which tooth is assigned to which measurement.

In preparation for the present analysis, the faunal remains were washed and labelled at the University of Jena according to the rules of the owner of the collection, the Thuringian State Office for Heritage and Archaeology. Find numbers from 1 to 661 were assigned: the horse teeth labelled by Musil (a total of 495 teeth/ numbers) were each given a new number per tooth. The remaining 166 numbers were assigned to the remaining, approx. 14,500 remains, namely for different sized groups of finds, which were rarely individual bones, but mostly numerous remains in smaller boxes, which can amount to 1,280 bones and 68 teeth with one number at the most. Thereafter, a list with the number of bone and tooth fragments for each find number was prepared, from which it became evident that the total number amounts to 15,126 remains with a total weight of around 175 kg. This huge amount is surprising as it is more than seven times larger than Musil´s count. Because this increase of the material to be studied was unknown when applying for funding, the proposed analysis had to be adapted accordingly. One consequence of this is that most of the remains are not individually numbered and thus could not be entered individually into a database. Also, the remains had to stay in their respective boxes and could not be grouped together according to species and skeletal elements. Among the animal remains are approximately 3,500 pieces with c. 15 kg of unidentified pieces or pieces for which the affiliation to the Magdalenian period is doubted that were not considered for the analysis. Therefore, the determination proceeded as follows: for each number, the remains were determined to species level and separated in different plastic bags. For the horse, the postcranial elements were grouped together but the teeth were determined and separately counted to milk and permanent teeth, incisors (upper and lower together), canines (upper and lower together), Premolars 3 and 4 and Molars 1 and 2 together, upper and lower counted separately, and the Premolars 2 and Molars 3 separately for upper/lower and left/right body side. For the other species, teeth were counted separately from postcranial elements, and in the case of the reindeer the antler fragments were counted separately as well. For each species, all element groups were weighed. This allowed to 1) treat the unexpected vast amount of material in a restrained amount of time and to 2) list important quantitative units for each species. The latter was done by applying experience and methods from the archaeozoological investigation of Upper Magdalenian sites Champréveyres and Monruz in Switzerland (Morel & Müller 1998; Müller 2013) – for example, quantification by NISP, the number of identified specimens, and WISP, the weight of identified specimens.

The occurrence of *Vulpes vulpes* (red fox) in the Upper Magdalenian of Central Europe is rarely discussed in detail: for example, some researchers take stratified red fox bones as evidence of presence in the Upper Magdalenian (Germonpré & Sablin 2004; Sommer & Benecke 2005a; Küßner 2009: Tab. 225; Baumann et al. 2020). In contrast, red fox is absent at the Upper Magdalenian living floors of Monruz and Champréveyres as well as at Borsuka Cave, a stratified palaeontological site (Morel & Müller 1997: 71; Müller 2013; Marcisczak et al. 2017). At other sites affiliation of red fox to the Magdalenian is formulated very vaguely (Albrecht et al. 1983: 78 & 152; Bodu et al. 2006: 19 & 152; Street & Turner 2013: 137; Julien & Karlin 2014: 78; Conard et al. 2019: 169-173, 245 & Tab. 57; Wong et al. 2020), at Felsställe most of the few red fox remains were found beside a recent pit (Kind 1987: 306-307). For Teufelsbrücke with its problematic stratigraphy and mixing of Pleistocene and Holocene taxa (see chapter Stratigraphy), without radiocarbon dating red fox bones, the occurrence of Late Weichselian *Vulpes vulpes* is impossible to prove. Thus, for this study, the distinction of arctic and red fox was done by dimensions of the teeth (Poplin 1976). Postcranial bones that appeared to be too large for arctic fox were excluded but both teeth and small postcranial bones are presented in table 3 under the category *Alopex/Vulpes*. The same problems influence the determination of hare species since European hare is not to be expected in a Central European Magdalenian context (see Thulin 2003 and Veitschegger et al. 2015 in contrast to Wong et al. 2020). The distinction between Arctic hare and European hare is possible unequivocally with the dimensions of the incisors (Morel & Müller 1997: 83-85). All incisors were from arctic hare, and the other hare remains are grouped as arctic hare as well for ease of presentation.

In archaeozoological studies great importance is laid on the estimation of the MNI for evaluating the economic significance of each species (Müller 2013: 18 & 39). It can be computed by simply counting the number of each skeletal elements for each body side and taking the highest number as the so called ´standard´ MNI. For the postcranial elements, the so-called ´landmarks method´ can be applied (Dobney & Rielly 1988; Stiner 1991), and, as was shown for Monruz, similar results as for teeth can be obtained (Tab. 2). However, grouping the teeth of Monruz to single years up to the age of eight years – older than that it was deemed not reliable anymore – and grouping series of teeth belonging to the same individual using morphological characteristics of the enamel folds (Müller 2013: 45-50), extended the MNI to 2.5 - 3 folds higher than the standard MNI (Tab. 2). At Monruz this extension is due to several reasons: since the M3 is the tooth with the highest count, animals too young to have this tooth present (younger than 3 years) will be missed when counting the standard MNI. Also, when individuals are determined per year classes, the sum of all individuals per year will be higher since for some year classes, some teeth may have the highest count while others are highest in other year classes. Grouping of teeth to individuals and assessing their year classes had been intended to be performed in the project, but, as explained above, due to the unexpected high amount of material had to be abandoned. The ´extended´ MNI of Teufelsbrücke will, therefore, be calculated with the figure obtained from the analysis of Monruz (Tab. 2) as an approximation.

Skeletal elements	Within age classes/years	MNI	Reference
Postcranial bones	no	23	Müller 2013: 48
Single teeth	no	21	Müller 2013: 45
Single teeth	within age classes	41	Müller 2013: 45
Teeth series of individuals	within single years	56	Müller 2013: 50

Tab. 2. MNI counts of horse at the Upper Magdalenian site Monruz.
Tab. 2. *Mindestindividuenzahlen für Pferd der Spätmagdalénien-Fundstelle Monruz.*

Because animal bone survival is a result of density-mediated attritional processes, different methods are available for interpretation of human consumption strategies (Lyman 1994: 223-292). As NISP-based utility curves do not capture transport strategies accurately (Schoville & Otárola-Castillo 2014: 2-5), for this study the relative weight of the different skeletal elements is used (Morel & Müller 1997: 12; Müller 2013: 34-39). For this, the relative abundances of bones of Teufelsbrücke (in percentage of the weight of the entire horse material) was compared to those of the different skeletal elements of a recent skeleton of a horse from the Camargue (South France). This had already been done for the studies of Champréveyres and Monruz (Morel & Müller 1997: Fig. 17; Müller 2013: 34, Fig. 28).

To determine the season of occupation of the Teufelsbrücke, the age estimation of the very young horse individuals yields the most reliable results (Morel & Müller 1997: 30-31; Müller 2013: 185 & 194). For this reason, teeth of the very young horses were screened for individuals of less than one year of age by using the criteria for age estimation established from more than 20 recent horse skulls which are published in detail by Müller (2013: 193-286).

For reasons already explained, the age structure of hunted horses could not be elaborated using series of horse teeth of different age classes, as it was done for Monruz (Müller 2013). However, a somewhat reduced form could be established. It has been shown that the height, i.e. the state of abrasion, have a relatively good correlation to the age of the animals (Levine 1982; Fernandez & Legendre 2003). It should be mentioned that these authors set the total life span of a horse at 25 years, which appears for a Lateglacial setting quite long, but cannot be discussed here. The height scores of Fernandez & Legendre (2003: Tab. 1) were used for this study to interpret the height of the lower right third molars, which was measured when possible. These teeth start to be present in archaeological material at the age of three years, but the root has not formed yet. For the age classes of 3-4 years and 4-5 years, morphology of the abrasion surface was used as criterion. In order to obtain the number of individuals younger than three years, the milk premolars were used, and here as well, the year classes were established using the abrasion status, i.e. the height of the teeth, while using in addition the comparison collection as published in Müller (2013: 193-286). For each year class, the tooth with the highest count was taken as the number of horses for the age class.

Species

It is well known that in a cave site, animal predators may be responsible for the accumulation of some remains (see references in Bourgeon & Burke 2021: 9-10). However, for Teufelsbrücke almost complete absence of gnawing marks (less than ten specimens), numerous cut marks on bones, high fragmentation of bones with percussion marks, species and skeletal element representation comparable to other contemporaneous sites (see "The horse remains"), as well as the huge amount of human-made artefacts all demonstrate that the majority of the animal bones are indeed leftovers from human consumption of hunted prey.

About 11,500 specimens with a weight of c. 160 kg could be determined to species level (Tab. 3). Of these, approximately 9,000 pieces are the remains of wild horse weighing around 148 kg. The 'standard' MNI for the horse is 66, which will be discussed in more detail further below (see "Minimum number of individuals"). Among the ruminants, the second most important larger animal species according to WISP is the reindeer with 764 fragments and weighing over 5.6 kg, of which 106 are teeth, and 174 antler fragments. The standard MNI for the reindeer is seven individuals owing to seven fragments of the left proximal ulna/radius. The next

Species	NISP WISP	Teeth	Non teeth	Antler	Total	(standard) MNI
Wild horse (*Equus ferus*)	NISP (N) WISP (g)	2,278 52,596	6,761 95,735	- -	9,039 148,331	66
Reindeer (*Rangifer tarandus*)	NISP (N) WISP (g)	106 580	484 3,892	174 2,195	764 5,667	7
Large bovid (*cf. Bison priscus*)	NISP (N) WISP (g)	- -	5 150	- -	5 150	1
Ibex (*Capra ibex*)	NISP (N) WISP (g)	25 116	110 1,736	- -	135 1,852	3
Woolly rhinoceros (*Coelodonta antiquitatis*)	NISP (N) WISP (g)	4 19	3 108	- -	7 127	1
Mammoth (*Mammuthus primigenius*)	NISP (N) WISP (g)	9 41	- -	- -	9 41	1
Artic hare (*Lepus timidus*)	NISP (N) WISP (g)	85 70	1,049 1,877	- -	1,134 1,947	36
Marmot (*Marmota marmota*)	NISP (N) WISP (g)	6 5	1 1	- -	7 6	(4)*
Brown bear (*Ursus arctos*)	NISP (N) WISP (g)	7 18	87 222	- -	94 240	1
Arctic/red fox (*Alopex/Vulpes*)	NISP (N) WISP (g)	78 94	81 134	- -	159 228	10
Wolf/dog (*Canis* sp.)	NISP (N) WISP (g)	14 20	53 223	- -	67 243	1
Lynx (*Lynx lynx*)	NISP (N) WISP (g)	1 1	16 58	- -	17 59	1
Cave lion (*Panthera leo spelaea*)	NISP (N) WISP (g)	1 2	- -	- -	1 2	1
Wolverine (*Gulo gulo*)	NISP (N) WISP (g)	- -	1 13	- -	1 13	1
Ptarmigan (*Lagopus* sp.)	NISP (N) WISP (g)	- -	111 101	- -	111 101	20
Common raven (*Corvus corax*)	NISP (N) WISP (g)	- -	2 5	- -	2 5	1
Whooper swan (*Cygnus cygnus*)	NISP (N) WISP (g)	- -	1 4	- -	1 4	1
Total	NISP (N) WISP (g)	2,614 53,501	8,764 104,294	174 2,195	11,552 160,026	152

Tab. 3. Animal remains of Teufelsbrücke (all layers). *The brackets indicate that the MNI for marmot does not indicate hunted animals since the six incisors, four of which are from the right mandible, were most likely introduced to the site as ornamental objects.

Tab. 3. *Tierknochen aus der Teufelsbrücke (alle Schichten). *Die Klammern zeigen an, dass die Mindestindividuenzahlen für Murmeltiere nicht auf gejagte Tiere hinweisen, da die sechs Schneidezähne, von denen vier aus dem rechten Unterkiefer stammen, höchstwahrscheinlich als Schmuckstücke an den Fundort gebracht wurden.*

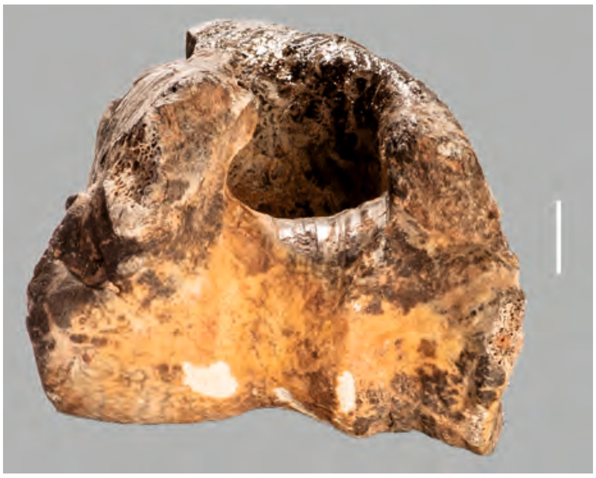

Fig. 5. *Capra ibex* from Teufelsbrücke – Distal part of humerus showing osteoarthritic grooving. Scale bar = 1 cm (photo: W. Müller).
Abb. 5. *Capra ibex aus der Teufelsbrücke – Distalteil eines Humerus mit durch Arthritis verursachten Rillen. Maβstab = 1 cm (Foto: W. Müller).*

Fig. 6. *Mammuthus primigenius* from Teufelsbrücke – Worked tusk fragment. Scale bar = 1 cm (photo: W. Müller).
Abb. 6. *Mammuthus primigenius aus der Teufelsbrücke – Bearbeitetes Elfenbein. Maβstab = 1 cm (Foto: W. Müller).*

highest count is reached by five distal right tibia fragments. The presence of 39 first phalanges would also translate to an MNI of five individuals. From the teeth, three lower right and lower left third molars would yield an MNI of three individuals. From a large bovid, probably the steppe bison, five post-cranial fragments weighing 150 g are determined, representing one individual at the least.

Ibex is present with 135 fragments, weighing around 1.8 kg, of which 25 are teeth. This species was not identified by Musil but first by Street (2000 – see comment in table 1) when selecting specimens for radiocarbon dating in the 1990s (Housley et al. 1997). The MNI of ibex amounts to three individuals due to the presence of three distal right humeri. Several other elements are present with two specimens each. Noteworthy is a very large individual of ibex, of which a distal humerus shows osteoarthritic grooving (Baker & Brothwell 1980: 114), probably as a result of its enormous weight and age (Fig. 5). Ibex is a rare species in Magdalenian sites north of Switzerland and the Swabian Jura: only four sites are mentioned by Maier (2015: Fig. 5.7 & Tab. A.8). Near to Teufelsbrücke, at Oelknitz, Musil (1985) determined an unstratified tooth from the upper jaw "probably of the species mentioned" (Musil 1985: 22 – translation by the authors), in contrast to Gaudzinski-Windheuser (2013: 128) who wrote only about a single distal metatarsal from ibex. At the Upper Magdalenian site Hostim (Czech Republic) five bones of ibex occur (Vencl 1995: 181). Far to the west, three bones of ibex were excavated 100 years ago with few Magdalenian artefacts in Wildweiberlei (Terberger 1993: 183). At Rytivská (Czech Republic) no ibex is present (Nývltová-Fišková 2002: 293) but only bones from the genus Ovis/Capra, dating to the Holocene. In contrast, a new excavation, where ibex occurs (but stratified with c. 14 ka calBP old, radiocarbon dated charcoal and Hamburgian-like lithic tools), is situated in the Tatra mountains of Poland (Valde-Novak et al. 2022).

At Teufelsbrücke, from the woolly rhinoceros, seven fragments were identified with a weight of 100 g. These are four fragments of heavily worn teeth, two ribs and the second phalanx that was radiocarbon dated. Musil mentioned seven pieces of 2-5 cm long mammoth ivory (Feustel 1980a: Fig. 15, 14-17; Feustel 1980b: 9-10). These pieces were not part of the material studied here, however, a worked fragment of a tusk was identified (Fig. 6), as well as some other fragments of a tusk and some fragments of molar teeth bound in sinter, altogether nine fragments of approximately 41 g. These pieces prove the presence of one individual of a

Fig. 7. *Marmota marmota* from Teufelsbrücke – Metatarsus VI. Scale bar = 1 cm (photo: W. Müller).
Abb. 7. *Marmota marmota aus der Teufelsbrücke – Metatarsus VI. Maβstab = 1 cm (Foto: W. Müller).*

mammoth, even though one has to admit that these teeth could have been brought into the site separately from an entire carcass.

In terms of numbers of remains (NISP), the second most common species is the arctic hare with 1,134 remains that, however, only make up 1.9 kg, of which 85 are teeth. The standard MNI amounts to 36 individuals due to the left distal humeri. There are also 35 left and 31 right scapulae, 31 left and 24 right mandibles, 24 left and 25 right proximal ulnae and 24 left distal femora. Musil identified one incisor of a marmot (Feustel 1980b: 11) but did not mention cut marks. Von Knorre found three more incisors among the remains of the microfauna (Feustel 1980b: 63), and did not mention cut marks either. In the present study, six incisors were found. All are the distal part of the tooth, all bear the characteristic cut marks (see chapter Worked bones and teeth) and have to be considered from a typological sense of view, as pendants. They are included in the present count (Tab. 3) but will be discussed in the chapter on worked objects. In addition, one postcranial element, a fourth metatarsal of a marmot (Tab. 3), has been identified (Fig. 7). It bears small cut marks that appear to be of modern origin. Since no other skeletal elements of marmot are present it has to be asked whether marmot was part of the faunal community of the area as it does not occur in other Upper Magdalenian sites of Central Germany (Küßner 2009: Tab. 225) or if the marmot remains were imported from areas where the species occurred, maybe from the area of today´s Poland (Lasota-Moskolewska 2014; Nadachowski et al. 2014). For the incisors, this seems to be the most plausible explanation (Surmely et al. 2019), since only the distal parts of the teeth, the final products, were found and no root parts of the tooth. For the metatarsal bone it could be envisioned that this bone was still attached to a skin that has been introduced from afar as well.

Carnivores are present with six species indicating that they were targeted frequently. The arctic fox is the most common with 159 pieces/228 g, followed by the brown bear with 94 pieces/240 g and the dog/wolf with 67 pieces/243 g. The number of teeth for these three species are 78, 7, and 14 respectively. For fox the standard MNI can be given with ten owing to ten left mandibles. From the right mandible, nine pieces are present. Postcranial elements are less numerous, with five left distal humeri and five left distal femora yielding the highest numbers. However, as one fox bone was radiocarbon dated c. 1,000 years earlier than the Upper Magdalenian of the Teufelsbrücke (see chapter Chronostratigraphy) presence of fox may not be related only to human occupation. One fragment of a mandible could be determined as wolverine: the teeth are missing but some broken roots are still in their alveoli sockets (Fig. 8). Arctic fox, wolf, wolverine and brown bear are typical species of the Late Weichselian faunal community (Sommer & Benecke 2004; Sommer & Benecke 2005a; Sommer & Benecke 2005b). Dog was part of the Upper Magdalenian human way of life (Morel & Müller 1997: 67-70; Boudadi-Maligne et al. 2012; Müller 2013: 138-139), but the determination of Musil (2000) of small canid bones from the

Fig. 8. *Gulo gulo* from Teufelsbrücke – Left mandible. Scale bar = 1 cm (photo: W. Müller).
Abb. 8. *Gulo gulo aus der Teufelsbrücke – Linkes Unterkieferfragment. Maßstab = 1 cm (Foto: W. Müller).*

Fig. 9. *Panthera leo spelaea* from Teufelsbrücke – Lower right milk canine. Scale bar = 1 cm (photo: W. Müller).
Abb. 9. *Panthera leo spelaea aus der Teufelsbrücke – Rechter, unterer Milcheckzahn. Maßstab = 1 cm (Foto: W. Müller).*

Teufelsbrücke is not accepted by everyone (Benecke 1987: 47; Morey 2010: 23-24; Vigne 2005: 284) and will not be discussed here. For the lynx, which had not been identified by Musil (Feustel 1980b), 17 fragments were determined, weighing 59 g, among them one tooth. Musil determined a complete lynx mandible in the nearby Upper Palaeolithic site Kniegrotte but doubted that it should be coming from the Pleistocene layers since he considered it to be a typical forest species (Feustel 1974: 31). Yet, lynx has been shown to be part of the tree-less steppe/tundra fauna during the Upper Magdalenian in Switzerland (Morel & Müller 1997: 72-73; see also Sommer & Benecke 2006: 11) and is also present at the Upper Magdalenian site Lengefeld-Bad Kösen, c. 70 km north of Teufelsbrücke (Richter et al. 2021: 76). Musil attributed seven bones of a neonate to lion but had no comparison material and was therefore not sure if his determination was correct (Feustel 1980b: 11). These remains were not found in the present material, however, one milk canine of a lion cub was identified: it is a lower right milk canine and it even bears a fine cut mark (Fig. 9). The tip of the crown is already a bit flattened, indicating that it had been in use already for a little while. The partly broken root is still very thin and does not show any sign of resorption caused by the developing permanent tooth. Since the milk teeth of African lion break through at the age of three weeks, and will be replaced by 12-15 months of age (Smuts et al. 1978), it can only be estimated that this individual was probably more than two months, but probably not more than six months old. It cannot be assessed whether Musil's estimation of ´neonate´ could comprise an individual of two months of age. Therefore, it remains possible that this tooth belongs to the same individual as the bones found by Musil, thus contributing another specimen to prove presence of the cave lion in the Late Weichselian of Central Europe (Sommer & Benecke 2006; Stuart & Lister 2011).

Musil reports a first phalanx that he attributes to a leopard and indicates its length with 29.5 mm. Another first phalanx he attributes to probably leopard (*Panthera* cf. *pardus*) because, albeit its length of 29.2 mm, its gracility leaves him with doubts (Feustel 1980b: 11 & 14). Why the measurements led him to the attribution of leopard remains unclear. Phalanges from a male lynx from the comparative collection of the archaeozoological lab of the University of Neuchâtel range from 30-40 mm. A Late Weichselian leopard should weigh about three times as much as a lynx and the phalanges should, therefore, be much larger than those of the lynx. Thus, the presence of *Panthera pardus* in Teufelsbrücke should be dismissed: Teufelsbrücke does not contribute to the discussion of this rare, snow leopard-like cat in Late Glacial Europe (Marciszak et al. 2022).

Of the bird bones present in the assemblage, those of ptarmigans are probably the ones most certainly attributable to the Late Pleistocene (Tab. 3). These are 111 fragments with a weight of 101 g. One fragment of a sternum of a whooper swan is noteworthy as it is identifiable morphologically with certainty to this species because this skeletal element has a special form (Fitch 1999). Musil mentions a humerus of a mute swan, insisting that it cannot be from whooper swan because of its size. This humerus was not found in the present material. One femur and one coracoid of common raven are present and both bear cut marks. Therefore, they most likely belong to the Magdalenian assemblage.

When comparing the mammal species from this study with those from the investigation done by Musil (Tab. 4) the following differences can be seen: the dominance of horse is increased to almost 80 % of the remains, followed by arctic hare and reindeer representing less than 10 %

Species	Analysis of the 1970s	This analysis
	NISP (Bock et al. 2017: 12)	NISP (Tab. 2)
Horse (*Equus ferus*)	52.6 % (N = 1,044)	79 % (N = 9,039)
Arctic hare (*Lepus timidus*)	22.8 % (N = 453)	9.9 % (N = 1,134)
Reindeer (*Rangifer tarandus*)	14.5 % (N = 288)	6.7 % (N = 764)
Fox (*Alopex/Vulpes*)	4.7 % (N = 93)	1.4 % (N = 159)
Ibex (*Capra ibex*)	< 1 % (N = 2)	1.2 % (N = 135)
Wolf/dog (*Canis* sp.)	1.5 % (N = 29)	< 1 % (N = 67)
Brown bear (*Ursus arctos*)	< 1 % (N = 13)	< 1 % (N = 94)
Cave lion (*Panthera leo spelaea*)	< 1 % (N = 6)	< 1 % (N = 1)
cf. Bison (cf. *Bison priscus*)	< 1 % (N = 3)	< 1 % (N = 5)
Marmot (*Marmota marmota*)	< 1 % (N = 4)	< 1 % (N = 7)
Mammoth (*Mammuthus primigenius*)	< 1 %	< 1 % (N = 9)
Woolly rhinoceros (*Coelodonta antiquitatis*)	-	< 1 % (N = 6)
Lynx (*Lynx lynx*)	-	< 1 % (N = 17)
Wolverine (*Gulo gulo*)	-	< 1 % (N = 1)
Saiga antelope (*Saiga tatarica*)	1.3 % (N = 25)	-
Leopard (*Panthera pardus*)	< 1 % (N = 2)	-
Total	100 % (N = 1,961)	100 % (N = 11,438)

Tab. 4. Comparison of mammal species of Teufelsbrücke by relative amount of NISP between the investigation in the 1970s and this article.
Tab. 4. *Vergleich der relativen Häufigkeit bestimmbarer Knochen der Säugetierarten aus der Grabung der 1970er-Jahre in der Teufelsbrücke und der hier vorgelegten Arbeit.*

Skeletal part	NISP (N	WISP(g)
Teeth fragments (premolars and molars)	602	52,596
Teeth fragments (incisors)	109	
Upper premolars and molars	476	
Lower premolars and molars	714	
Incisors	348	
Canines	29	
Postcranial bones	6,764	95,775
Total	9,042	148,371

Tab. 5. Horse remains at the Teufelsbrücke.
Tab. 5. *Pferdezähne und -knochen der Teufelsbrücke.*

each. The presence of leopard at Teufelsbrücke was shown to be likely a misidentification. Mammal species identified new in the present study include ibex, lynx, rhinoceros, wolverine. Musil was familiar with the presence of the Saiga antelope in the Kniegrotte, an Upper Palaeolithic site near Teufelsbrücke (Feustel 1974: 34-36; Kahlke 1990; Höck 2000: Tab. 3; Nadachowski et al. 2016). However, at Teufelsbrücke in terms of present and absent species, the saiga antelope could not be found: Musil determined 25 specimens representing seven individuals (Feustel 1980b). Yet, since Musil did not identify ibex, the possibility of a mix-up of the two species cannot be ruled out.

The horse remains

Number and weight of identified specimens

A huge amount of horse bones characterizes most Upper Magdalenian sites in Central Germany (Küßner 2009: Tab. 225; Pasda & Weiß 2020: Tab. 3). As horse bones represent the most dominant animal species of the Teufelsbrücke (Tab. 3), these bones are presented in more detail. At Teufelsbrücke, postcranial bones make up about two thirds (64.5 %) of the remains by weight, and teeth the remaining one third (35.4 %) (Tab. 5). The average weight of teeth (23 g) is higher than that of the postcranial fragments (14 g), indicating a considerable fragmentation of the postcranial elements.

Minimum number of individuals

Musil gives the MNI for each layer or layer packages (Feustel 1980b). If these numbers were added one would arrive at 70 horse individuals. Turner (2003) reckoned this number to be too high and proposed to add only Musil's MNI of layer 3 and 4, to arrive at an MNI of 47 horses. Since the layers are now recognised as not being a stratigraphic succession (see chapter Sediments and preservation of faunal material), this procedure is not permissible. In this study the teeth that could be quickly and reliably determined were counted, i.e. the front and rear jugulars, P2 and M3. The lower right M3 reaches the highest number (Tab. 6), thus allowing for establishing the 'standard' MNI at 66 individuals. Taking the numbers of Monruz as a template (Tab. 2), a 2.5 to 3-fold increase of the standard MNI results in an extended MNI of 165-198 horses at Teufelsbrücke.

Body part representation

In order to verify the relative abundance of the different skeletal elements, remains of five randomly selected boxes were determined. The postcranial horse remains were determined cursorily and weighed, the teeth being added to the cranium or mandible, respectively. The weight of the individual skeletal elements as percentages of the weight of all horse remains were then compared to those obtained for a skeleton of a recent "Camargue" horse (Fig. 10).

Figure 10 shows two rather similar curves of weighted skeletal elements between the Teufelsbrücke horse bones and the comparative horse. However, at Teufelsbrücke, teeth of upper and lower jaws (together with skull and mandible) are overrepresented by a factor of about 2.5, while at Monruz only by a factor of two (Müller 2013: Fig. 26). This overrepresentation of teeth is an overall observed occurrence and explained generally by the better preservation of teeth as compared to bones. In addition, for Teufelsbrücke, due to the determination style, post-cranial fragments were less frequently attributed to a certain skeletal element, whereas teeth were always counted as teeth and can be attributed in most cases to lower or upper teeth. That some skeletal elements are completely missing (Fig. 10) is due to the small sample size, or, in the case of ribs, vertebras, carpal and tarsal bones, were not counted at all since their correct identification would have taken too much time. Despite these limitations and the fact that the frequencies were obtained only for a fraction of the entire material, the essential result of this comparison remains that skeletal elements from all body regions of horse are present at Teufelsbrücke, indicating the absence of differential transport of certain body parts. This aspect will be treated in more detail below (see chapter Discussion).

Seasonal determination

Only 18 teeth of very young horses could be used to determine the season of occupation of Teufelsbrücke (Tab. 7); for other species, no elements useful as seasonal indicators were found. Obviously, the number of teeth does not represent the number of individuals since the teeth may stem from the same individuals. However, what can be seen from these numbers is the fact that very young individuals of less than two months are missing, as well as individuals between more than six months up to one year. When supposing the birth of horses in April/May (Morel & Müller 1997: 44) the teeth indicate killing of horses between June/July and October/November. Therefore, the summer and the autumn season seem to be well represented. If one assumes that the six months old individuals were born at the beginning of spring and that the season with a mean temperature of 0 °C lasted six months (Frenzel 1983: 487 & Tab. d), these individuals would indicate that hunting horses at Teufelsbrücke was not performed in winter.

Age structure

The height of 47 teeth could be measured (Tab. 8) to get the state of abrasion which correlates well with age.

M^3 sin.	P^2 sin.	P^2 dext.	M^3 dext.
N = 40	N = 33	N = 33	N = 37
N = 57	N = 32	N = 34	N = 66
M_3 sin.	P_2 sin.	P_2 dext.	M_3 dext.

Tab. 6. Tooth count for premolars 2 and molars 3 of horse from Teufelsbrücke.
Tab. 6. *Anzahl von 2. Prämolar und 3. Molar von Pferden der Teufelsbrücke.*

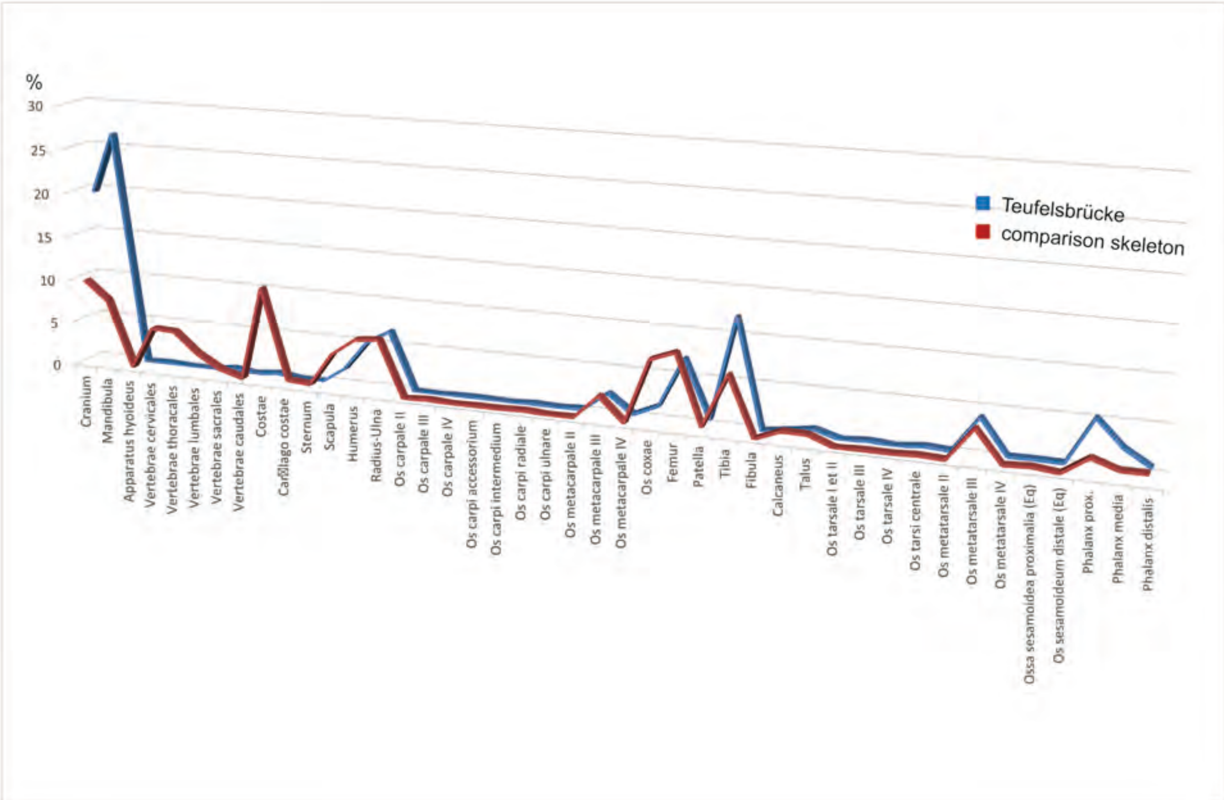

Fig. 10. Comparison of the relative abundance of skeletal elements of the horse from Teufelsbrücke (blue) with a skeleton of the comparison collection (red) in percent of the entire skeleton. Teeth are added to the skull or the mandible, respectively (graphic: W. Müller).
Abb. 10. *Vergleich der relativen Häufigkeit der Skelettelemente vom Pferd aus der Teufelsbrücke (blau) und der eines Pferdeskeletts aus der osteologischen Vergleichssammlung (rot) in Prozent des Gesamtskeletts. Zähne wurden dem Schädel oder dem Unterkiefer zugeordnet (Grafik: W. Müller).*

Interpretation of data is done with information on ethology and sociology of recent feral horses (Berger 1977; Olsen 1989; Volf 1996; West 1997).

There are four individuals proven for year classes 0-1 and 1-2 years, and three for year classes 2-3 and 3-4 years. Since those up to three years of age would be animals that are still living in their family group, this does indicate that family groups were certainly targeted. The older year classes up to ten years seem to alternate in their frequency which is not easily explicable. The overall trend, however, is that from the groups 4-9 years, 23 individuals are represented, which is half of all individuals that could be included in this analysis. These 23 individuals would be prime-adult animals, for

Specimen	N	Age
Premolars	2	2 - 3 months
Incisors	2	2 - 3 months
Premolars	1	4 months
Incisors	3	4 months
Premolars	4	4 - 6 months
Premolars	6	6 months

Tab. 7. Age estimation of horse teeth younger than one year from Teufelsbrücke.
Tab. 7. *Altersbestimmung der Zähne von maximal einjährigen Pferden der Teufelsbrücke.*

Age class (years)	Lower right M3 (N)	P dec. (N)	Total (N)
0-1	-	4	4
1-2	-	4	4
2-3	1	3	4
3-4	3	-	3
4-5	7	-	7
5-6	1	-	1
6-7	7	-	7
7-8	-	-	-
8-9	8	-	8
9-10	-	-	-
10-11	-	-	-
11-12	2	-	2
12-13	1	-	1
13-14	2	-	2
14-15	-	-	-
15-16	1	-	1
16-17	-	-	-
17-18	-	-	-
18-19	-	-	-
19-20	-	-	-
>20	3	-	3
Total (n)	36	11	47

Tab. 8. Age classes of horse teeth from Teufelsbrücke.
Tab. 8. *Altersklassen der Pferdezähne der Teufelsbrücke.*

Fig. 11. *Rangifer tarandus* from Teufelsbrücke – Four examples of cut incisors (out of a total of 57 specimens). Scale bar = 1 cm (photo: W. Müller).
Abb. 11. *Rangifer tarandus aus der Teufelsbrücke – Vier Beispiele abgeschnittener Schneidezähne (von insgesamt 57 Exemplaren). Maßstab = 1 cm (Foto: W. Müller).*

Fig. 13. *Lepus timidus* from Teufelsbrücke – Femur with artificial hole. Scale bar = 1 cm (photo: W. Müller).
Abb. 13. *Lepus timidus aus der Teufelsbrücke – Femur mit artifizieller Durchlochung. Maßstab = 1 cm (Foto: W. Müller).*

females certainly individuals in the reproductive age. For males in a natural setting, animals younger than eight years are unlikely to be able to control a family group. The older age classes, the +9-year-old animals, are represented by nine horses only, which is to be expected since there are fewer of them in the population. Their presence indicates that even very old animals were hunted.

Worked bones and teeth

Feustel (1980a) published about 400 bone artefacts that were not part of the assemblage investigated here. Therefore, it should not come as a surprise that some more worked bones and teeth were found in the present study. Among the material set aside as microfauna (German: "Kleintierknochen"), which was hence probably only studied by von Knorre and not by Musil (Feustel 1980b), 57 cut reindeer incisors were retrieved (Fig. 11). These teeth are taken en bloc, from a flip of gum, so as to form an element of adornment composed of eight white pearls which can, for example, be worn as a necklace or worn on clothing (Müller 2013: 170). The first description of such artefacts dates to the early 1970s (Poplin 1972), so that it is quite plausible that von Knorre was not aware of them: without prior knowledge it is very difficult to notice the cut marks, especially if one is concentrated on the identification of the microfauna. The same is true for the cut marmot incisors (Fig. 12), of which six were found in the present study (see "Species"). All are lower incisors, two from the left side and four from the right. Although

Fig. 12. *Marmota marmota* from Teufelsbrücke – Six cut lower incisors, lateral and medial views. Scale bar = 1 cm (photo: W. Müller).
Abb. 12. *Marmota marmota aus der Teufelsbrücke – Sechs untere abgeschnittene Schneidezähne, laterale und mediale Ansicht. Maßstab = 1 cm (Foto: W. Müller).*

Fig. 14. Tubular beads from Teufelsbrücke. Scale bar = 1 cm (photo: W. Müller).
Abb. 14. *Röhrenförmige Perlen aus der Teufelsbrücke. Maßstab = 1 cm (Foto: W. Müller).*

von Knorre identified three, and Musil one incisor (Feustel 1980b), the cut marks went unnoticed. Furthermore, two fragmented canines of arctic fox show part of a human-made hole. Cut reindeer and marmot incisors as well as pierced incisors of arctic fox are present in many Magdalenian sites (Albrecht et al. 1983: 133-153; Leesch 1997: 96-97; Mania 1999: 115; Höck 2000: 146; Álvarez Fernández 2005; Bullinger & Müller 2005; Bullinger et al. 2006: 149-152; Costamagno et al. 2018; Müller 2013: 171; Street & Turner 2013: 131-133 & 175-176; Surmely et al. 2019: 13).

From arctic hare, the head of the femur is present that shows one small drilled hole and the edge of a large hole, all of which have a polished appearance (Fig. 13). Tubular beads occur in many Upper Magdalenian sites (Bullinger et al. 2006: 154), also in Central Germany (Feustel 1974: Fig. 71: 8; Plate 23: 7; Mania 1999: 116; Gaudzinski-Windheuser 2013: 307, 389), and were already mentioned from Teufelsbrücke (Feustel 1980a: 34). Two more pieces with the characteristic cut marks were found during this study (Fig. 14). The species could not be determined but the beads may be made out of metapodials of a hare/fox-sized animal. One bead was cut on one side before the break, the other was cut on both sides.

From a mammoth tusk, a small fragment with cut and scraping marks is present, that has split off a larger fragment (Fig. 6). Since it was wrapped separately in newspaper it was recognized as a 'special' piece so that this might be one of the pieces already mentioned by Feustel (1980a). Worked ivory does occur in Upper Magdalenian sites (Street & Turner 2013: 19-20), also in Central Germany (Mania 1999: 111-115; Höck 2000: 122-123; Gaudzinski-Windheuser 2013: 337-339; Müller et al. 2018/19: 9). Finally, several bones and antlers from which splinters had been extracted by grooving for the production of needles and spear points are attested, among them two metapodials of horse, a tibia of horse, a radius of arctic fox, and the

Fig. 15. *Lynx lynx* from Teufelsbrücke – Fibula used as core for groove-and-splinter technique. Scale bar = 1 cm (photo: W. Müller).

Abb. 15. *Lynx lynx aus der Teufelsbrücke – Fibula als Kern für Spantechnik. Maßstab = 1 cm (Foto: W. Müller).*

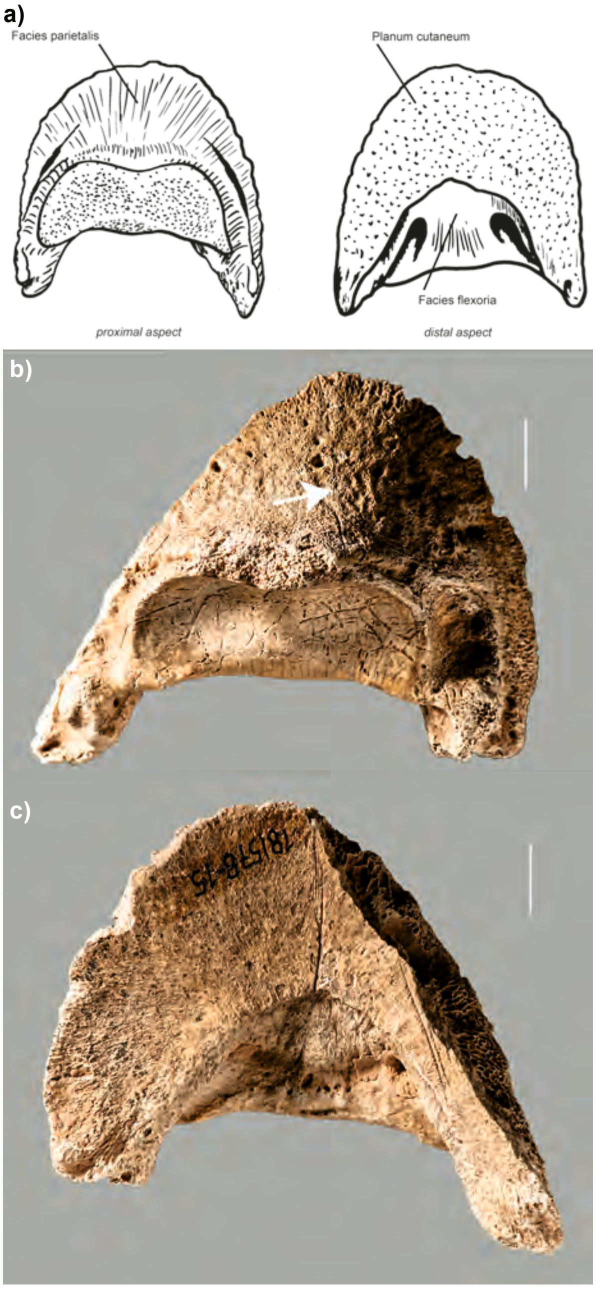

Fig. 16. *Equus ferus* from Teufelsbrücke – Distal phalanges, a) surface terms, b) proximal aspect with very light incision on Facies parietalis (arrow), c) distal aspect with rare, deep incisions on planum cutaneum. Scale bar = 1 cm (photo: W. Müller).

Abb. 16. *Equus ferus aus der Teufelsbrücke – Distale Phalangen, a) Flächenbezeichnungen, b) proximale Ansicht mit leichten Schnittspuren (Pfeil) auf der Facies parietalis, c) distale Ansicht mit seltenen, starken Einschnitten auf dem Planum cutaneum. Maßstab = 1 cm (Foto: W. Müller).*

fibula of lynx (Fig. 15). This variety is present also at other Upper Magdalenian sites (Berke 1987; Leesch 1997: 93-95 & 99-102; Höck 2000: 125-129; Bullinger et al. 2006: 142-146; Küßner 2009: 117; Gaudzinski-Windheuser 2013: 152, 155-156 & 282; Müller 2013: 167-168; Street & Turner 2013: 115-116 & 215).

Use of horn

Historic hunter-gatherers used horn of ungulates to make various tools, for example the Inuinnait of the Canadian arctic (Jenness 1946: 6, 69-72 & 98; Hahn 1980). Unfortunately, in palaeolithic sites the horn of hooves or of bovid horns have very little probability of being preserved. The exploitation of this raw material can only be documented indirectly by cut marks on the third phalanges or the horn cores. The material of the Teufelsbrücke was studied carefully for these cut marks, which can be only discerned under a stereomicroscope and with the light coming at almost a right angle to the viewing axis. From overall 61 pieces of third phalanx of horse, a total of 43 bear cut marks. Of the remaining 18 pieces, about half of them are either only partially present or the surface is badly preserved. The cut marks were found on all three surfaces of the third phalanx, 25 times on the Facies parietalis, 14 times on the Planum cutaneum, and nine times on the Facies flexoria (Fig. 16). These numbers clearly indicate that the exploitation of the horn of the horse hooves was a regular activity. Cut marks on the third phalanx of horses were so far observed at Kniegrotte (Berke 1989), Rond-du-Barry (Costamagno 1999), Solutré (Turner 2002), Roc-de-Sers (Brugère 2003), Monruz (Müller 2013), and Roc-de-Marcamps (Kuntz et al. 2015). On six out of seven reindeer third phalanges, cut marks were found as well (Fig. 17), indicating that even the horn of the hooves of this species was subject to extraction as well. Cut marks on reindeer third phalanges were also observed at Peyrazet (Costamagno et al. 2018), and even on third phalanges of saiga antelope at Saint-Germain-la-Rivière (Langlais et al. 2015). The difficulty to discern these cut marks let's one envision that this activity was most likely more widespread in the Magdalenian and that a systematic search should prove worthwhile to find more examples for the use of this raw material. Cut marks on horncores of bovids have not been documented so far. These skeletal elements are quite rare in archaeological material, but given the seemingly ubiquitous exploitation of the horn of hooves of horse, reindeer, and saiga, it would be surprising if the horn of bovids had not been exploited as well. A careful examination of horncore fragments is therefore definitely warranted.

Fig. 17. *Rangifer tarandus* from Teufelsbrücke – Distal phalanx, distal aspect with cut marks (enlargement of square on left side). Scale bar = 1 cm (photo: W. Müller).

Abb. 17. *Rangifer tarandus aus der Teufelsbrücke – Distale Phalange, distale Ansicht mit Schnittspuren (Vergrösserung des Vierecks links). Maßstab = 1 cm (Foto: W. Müller).*

Worked non-bone object

Among the numerous unstratified faunal remains, a small artefact, 29 x 7 x 5 mm, was recovered during the archeozoological study (Fig. 18). It is made from a yellowish to light brown, solidified silty material that shows lithologic resemblance with three perforated objects from the Magdalenian site Monruz (black and white photographs in Bullinger 2006: Fig. 240: a & b, Fig. 241: a), where this raw material is supposed to represent a variety of oil shale. This type of "rock" occurs together with jet and stems probably from the so-called "Posidonia Shale", Lias epsilon, Lower Toarcien of the Swabian Alb (Ligouis 2006; Peschaux & Ligouis 2023). This determination based only on macroscopic inspection would however need to be confirmed with a petrographic analysis.

The piece has two more or less flat surfaces, called dorsal and ventral (Fig. 18: a & c), and two rounded sides (Fig. 18: b & d). Various traces of processing techniques can be discerned, so e.g. parallel striations (top left half of figure 18: b, bottom right tip of figure 18: b & d), indicative of grinding on some kind of stone slabs (Orłowska et al. 2022). Furthermore, on the dorsal and ventral surfaces (Fig. 18: a & c), longitudinal and oblique incisions can be recognized that seem to have been made by a flint tool. The artefact may be interpreted as a preform of a pièce arquée. Pièces arquées or "arched pieces are more or less elongated triangles (up to 70 mm long) with a rounded top and bevelled ends" (Peschaux & Ligouis 2023) and a central perforation or notch in its widest part. If it is indeed an unfinished form of a pièce arquée, the incisions on the dorsal and ventral surfaces could be interpreted as preparation for drilling.

Arched pieces occur most often in sites situated near the natural sources of jet, notably in the area of Swiss and Southwest German Jurassic chain, for example at Monruz, Moosbühl, Kesslerloch, Schweizersbild and Petersfels (Bullinger 2006: 160-161; Peschaux & Ligouis 2023: Tab. 1). In the Central German Magdalenian, jet artefacts have been found in a few sites (Álvarez-Fernández 2009: Fig. 13), notably in Teufelsbrücke and Kniegrotte, which have produced a few pearls (Feustel 1974: 115, 1980a: Abb. 14: 7, 8 & 12; Höck 2000: 144). Feustel (1974: 115) already assumed that the jet used in Kniegrotte came from the southern deposits mentioned above.

Fig. 18. Worked non-bone object from Teufelsbrücke – Scale bar = 1 cm (photos: W. Müller, drawing: C. Pasda).
Abb. 18. *Bearbeitetes Objekt aus der Teufelsbrücke – Maßstab = 1 cm (Photos: W. Müller, Zeichnung: C. Pasda).*

Discussion

The discovery of Upper Magdalenian living floors at Champréveyres and Monruz in Switzerland, their excavation, subsequent analysis, combining intensive refitting, reconstruction of the operation chain, typology and spatial data, was an important step in presenting a new view on the lifeways of Upper Palaeolithic humans (Leesch 1997; Leesch & Bullinger 2012; Leesch 2014; Leesch et al. 2019). According to this interpretation, the impressive archaeological record of Upper Magdalenian sites – many sites are characterized by thousands of lithics, tons of rocks, presence of hearths, high amount of animal individuals – is not seen as evidence of hunter-gatherers living in ´base camps´ with tents erected on stone pavements. In contrast, the material record of the Upper Magdalenian is seen as a result of a rather short occupation with consumption of prey and related domestic activities done by a small group using briefly a stone-covered hearth (Moseler 2020). According to the model developed for the two Swiss sites (Müller 2004; Müller et al. 2006; Müller 2013, Leesch et al. 2019: 115), a hunting expedition in the open, treeless steppe/ tundra had to be carried out far (i.e. several kilometres) away from a residential camp. Once the hunt was successful, the entire group would relocate directly to the kill site or close by (Fig. 19). Thereafter, during the time that the hunted large herbivores were consumed, the vicinity of the site could then be exploited for the smaller game in order to meet the demand for game with other qualities (Müller 2004). The time it took for consumption and related domestic activities was very

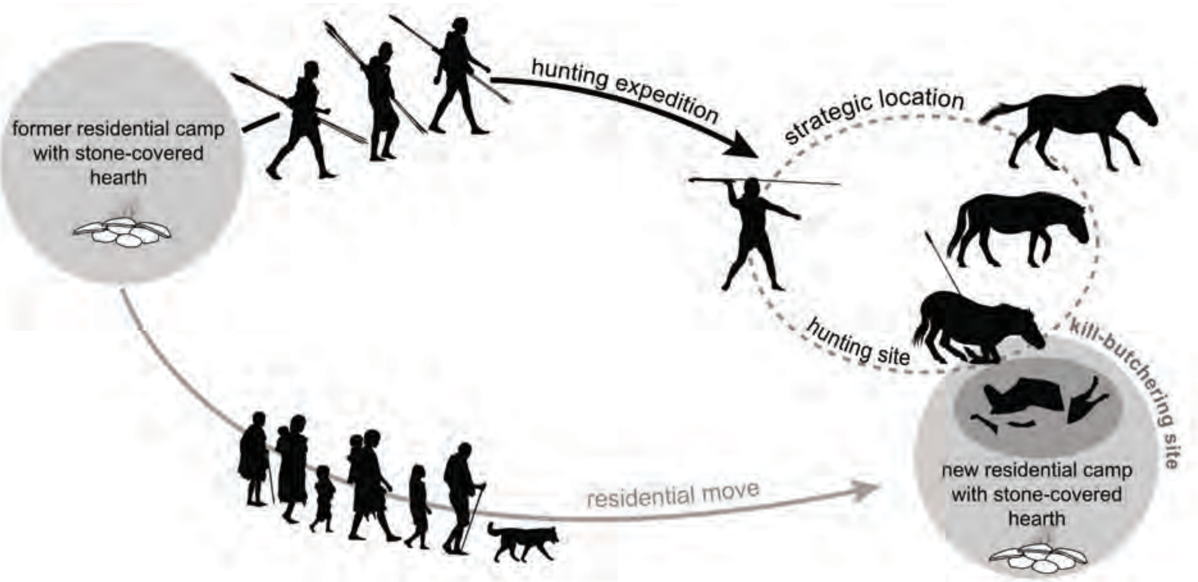

Fig. 19. Model of Upper Magdalenian hunting and group mobility (adapted from Leesch et al. 2019: 115, graphic: W. Müller).
Abb. 19. *Modell für den Zusammenhang zwischen Jagd und Gruppenmobilität im Spätmagdalénien (verändert nach Leesch et al. 2019: 115, Grafik: W. Müller).*

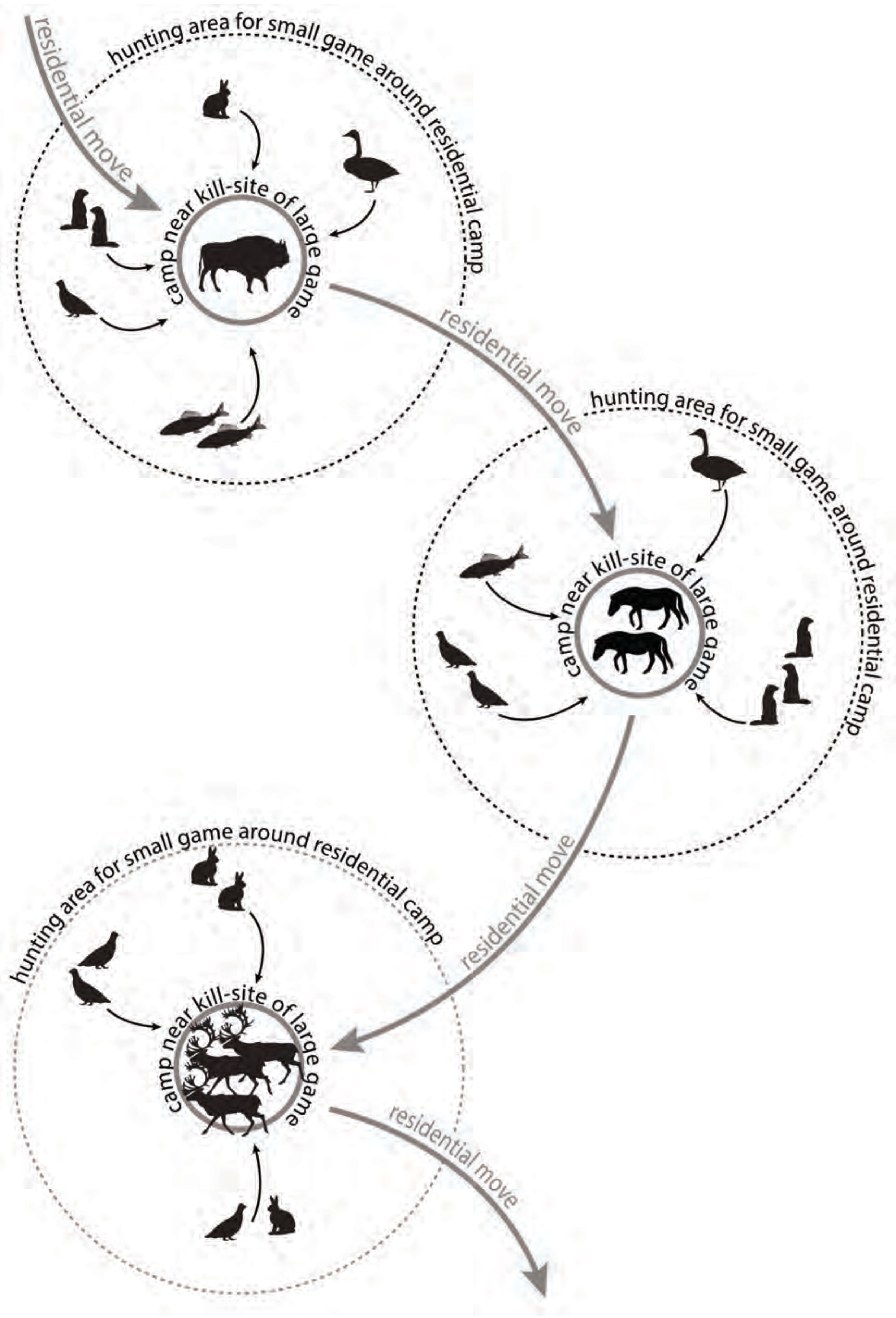

Fig. 20. Model of Upper Magdalenian residential mobility (adapted from Leesch et al. 2019: 122, graphic: W. Müller).
Abb. 20. *Modell der Landnutzung im Spätmagdalénien (verändert nach Leesch et al. 2019: 122, Grafik: W. Müller).*

short. Thus, after a brief period, a new hunting expedition was necessary some distance from the camp and, upon success, a residential move to the new kill site followed (Fig. 20). This model of the human lifeways in the Late Pleistocene has deep implications on research on demography of past human hunter-gatherers as well as on models for human dispersal in Greenland-Stadial-2.1 (e.g. Pfeifer 2022), but it is not the scope of this article to discuss these issues here. Moreover, future research will show if this model can be applied to all sites of the Magdalenian culture, with its wide geographical range, different prey species, climate, topography, etc.

According to this model, many Upper Magdalenian sites in Europe are created by uniform activities connected with consumption of hunted prey and related domestic activities (Leesch et al. 2019: 80). This observation is supported by recent statistical analyses of Magdalenian lithic tools (Moseler 2020; Pasda & Weiß 2020). However, already 35 years ago no differences in domestic tool types between sites were detected, only the amount of backed bladelets varied (Kind 1987: 153-154; Bosselin & Djindjian 1988 - in our reading, the graphs of Richter (1990: 252), Siegmund (1990/91: 42) and Grimm (2019: Figs. 80-82) support this view). Variation in the amount of backed bladelets is not reflecting differences in human behaviour but more likely the excavation method, especially the application of detailed sediment water-screening (Kind 1987: 151; Djindjian 1988: 688; Leesch 1997: 79). In a recent plotting of tool type frequencies of sites across Europe, Maier (2015: 123) stated “that the main and most common tool classes, such as scrapers, burins, borers, backed bladelets, truncated pieces, and laterally retouched pieces do not exhibit any kind of directed spatial trends or clustering whatsoever.” He only saw differences in tool types which are younger intrusions (e.g. backed and shouldered points), which vary between researchers (e.g. splintered pieces) or are impossible to separate from natural damage, like notches and denticulates (Pasda & Weiß 2020: 64-65). This supports the interpretation of more or less uniform activities at hearths in the Upper Magdalenian (Leesch et al. 2019) and may allow taking numbers from the Swiss sites to discuss human activities at Teufelsbrücke.

The total amount of lithics excavated at Teufelsbrücke (see chapter Introduction) is well in accordance with sites like Monruz, Pincevent-IV20 and Pincevent-IV0 which result out of successive, brief human stays within a very short time period (Pasda & Weiß 2020: 61). According to an estimate based on Champréveyres and Monruz, not more than two or three horses could be killed during a single hunting event (Müller et al. 2006: 747; Leesch & Bullinger 2012: 172; Leesch 2014: 118). When taking the standard MNI of horse from Teufelsbrücke (Tab. 6) this may indicate that the whole assemblage of Teufelsbrücke is a result of consumption and related domestic activities after at least 20-30 successful hunting episodes of Magdalenian humans. When taking the ´extended´ MNI of 165-198 for horse c. 60-100 successful hunting trips are represented.

Category	Champréveyres: remains left by humans after using a hearth once (average)	Teufelsbrücke: all remains	Teufelsbrücke: number of hearth use phases
Burin spalls	N = 30	N = 292	10
Bone needles	N = 2	N = 28	14
Lithics	N = 416 (for lithics >1 cm)	N = 25,771 (for all lithics)	62
Horse	standard MNI = 1	standard MNI = 66	66
Cores	N = 3	N = 276	92
Backed bladelets	N = 11	N = 1,126	102
Domestic tools	N = 9	N = 1,100	122
Horse	standard MNI = 1	extended MNI = 165-198	165-198

Tab. 9. Comparison between Champréveyres and Teufelsbrücke. Data for hearths from Champréveyres B16, E21, I16, M17, N16 and K12 (Leesch 1997: fig. 214); data for hearths from Teufelsbrücke compiled from Feustel (1980a, 28, 48), Bock et al. (2017: tab. 1), Pasda & Weiß (2020: tab. 1, app. 2) and this study.

Tab. 9. *Vergleich zwischen Champréveyrres und Teufelsbrücke. Daten der Feuerstellen aus Champréveyres B16, E21, I16, M17, N16 und K12 (); Daten der Feuerstellen der Teufelsbrücke zusammengestellt aus Feustel (1980a, 28, 48), Bock et al. (2017: Tab. 1), Pasda & Weiß (2020: Tab. 1, Abb. 2) und dieser Studie.*

Leesch (1997) has extracted data from Champréveyres to show the amount of artefacts and prey remains which result out of a single use of a stone-covered hearth. Table 9 compares her numbers with that of Teufelsbrücke. As bone needles and burin spalls are underrepresented due to the excavation technique employed in the early 1970s (Leesch 1997: 77 & 97), the estimate of ten to fourteen occupation phases by these tools seems too low. The other categories, the total amount of lithics, the number of horses, cores and lithic tool types indicate that the number of reconstructed hearth use phases at Teufelsbrücke may be between 60 and 200.

Teufelsbrücke is not the only Upper Magdalenian site in Central Germany where, due to research which started in the late 19th century, c. 130 lithic assemblages from the Magdalenian and Final Palaeolithic are known (Küßner 2009: Map 1). This huge amount of data is in contrast to only, beside Teufelsbrücke, seven other sites with

Site	Summer	Autumn	Winter	Spring
Teufelsbrücke	x	x		
Nebra		x		
Saaleck		?	x	
Kniegrotte		x	x	x
Oelknitz				x

Tab. 10. Seasonal data from Magdalenian sites in Central Germany. references: see text. Seasonal data from Magdalenian sites in Central Germany; present (x).

Tab. 10. *Saisonale Daten aus Magdalénien-Fundstellen in Mitteldeutschland. Saisonale Daten aus Magdalénien-Fundstellen in Mitteldeutschland; vorhanden (x).*

detailed research in archaeozoology: Lausnitz (Feustel et al. 1962/63), Bad Frankenhausen (Teichert 1971), Saaleck (Nobis 1982), Kniegrotte (Berke 1989), Nebra (Mania 1999), Oelknitz (Brasser 2010/11; Gaudzinski-Windheuser 2013) and Lengefeld-Bad Kösen (Richter et al. 2021). The results of these investigations will be discussed now, together with the study of the Teufelsbrücke. However, it has to be emphasized that, concerning lithic typology (Bock et al. 2013; Bock et al. 2015; Bock et al. 2017; Pasda & Weiß 2020; Bodenschatz et al. 2021), only Nebra is close to Teufelsbrücke, in contrast to Saaleck and Lengefeld-Bad Kösen which show other frequencies in lithic tool types as well as in presence and absence of certain types of burins and backed bladelets. Kniegrotte and Oelknitz may include a somehow older variant of the Magdalenian.

Five sites show season of hunting (Tab. 10). Horse hunting at Teufelsbrücke was an activity which took place at least in the warm period (see chapter Seasonal determination). Hunting in autumn was also performed at Nebra, as shown by wear of milk teeth on a reindeer mandible (Mania 1999: 164). At Saaleck, a six to eight months old horse might be present, indicating a successful hunt in autumn according to Nobis (1982: 224) but an autumn to winter hunt according to the estimate made above (see chapter Seasonal determination). Due to presence of antlers, at Kniegrotte hunting of reindeer was done in autumn, maybe also in winter and spring, but foetal horse bones indicate horse hunting in winter (Berke 1989: 192). In the so-called ´area 1´ of Oelknitz, two teeth of a newborn and a few weeks old horse indicate hunting in spring (Gaudzinski-Windheuser 2013: 58 & 60). This shows that Upper Magdalenian humans have been present in Central Germany year-round. They did not leave Thuringia in the long period when the mean temperature of the coldest month was -25 °C (Coope & Elias 2000: 171; Leesch et al. 2004: 33; Müller 2013: 171-172). Also, no seasonal round, for example, between northern sites in the hilly lowlands (Saaleck and Nebra) and sites in the more mountainous region in the south (Teufelsbrücke, Kniegrotte, Oelknitz), can be seen (Tab. 10). This supports the model presented in figure 20 with opportunistic hunting when the main hunting prey was present year-round.

Site	Horse	Reindeer	MNI total
Bad Kösen-Lengefeld	5	3	8
Bad Frankenhausen	12	-	12
Lausnitz	15	3	18
Saaleck	20	-	20
Nebra	10	11	21
Teufelsbrücke	66	7	73
Kniegrotte	31-40	6 (without antler) 42 (with antler)	73-82

Tab. 11. Minimum number of horse and reindeer individuals (standard MNI) at Magdalenian sites in Central Germany. References: see text.
Tab. 11. *Mindestindividuenzahlen für Pferd und Rentier (Standard-MIZ) in Magdalénien-Fundstellen in Mitteldeutschland. Verweise siehe Text.*

In Central Germany, MNI counts of hunted individuals (Tab. 11) are hampered by bad preservation of bones (Saaleck), small excavation size (Bad Kösen-Lengefeld) or contradicting counts (Kniegrotte). However, horse is predominant at most sites but reindeer is present at Nebra and Kniegrotte also in high numbers. The total MNI counts do not indicate sites occupied over a very long period: comparable MNI counts are reported from newly excavated sites like Champréveyres, Monruz and Pincevent which were used during one season or successively for a few seasons only (Pasda & Weiß 2020: 63).

For horse, determination of sex is available only from two sites: at Lausnitz and Saaleck young mares predominate (Feustel et al. 1962/63: 74; Nobis 1982) in contrast to Oelknitz where prime-adult, male horses are present the most often (Brasser 2010/11: 28-29; Gaudzinski-Windheuser 2013: 61-66).

Already 40-50 years ago, height measurements of teeth were used at Saaleck, Lausnitz and Bad Frankenhausen to get data on age structure of hunted horses (Tab. 12). It has to be emphasized that interpretation is hampered by bad preservation as on these sites only one individual <1 year is present. This can also be seen by the fact that the number of young horses decreases when only low numbers of teeth characterize the site (Morel & Müller 1997: 44). However, the presence of young horses at nearly all sites indicates that family groups have been hunted. This makes also sense in terms of horse behaviour, because family groups have smaller territories and are more predictable in their daily movements (Müller 2013: 50). At Teufelsbrücke and Lengefeld-Bad Kösen, maybe also at Saaleck and Bad Frankenhausen (Tab. 12), as well as at Oelknitz (Brasser 2010/11: 28-29; Gaudzinski-Windheuser 2013: 61-66) prime-adult horses predominate. Only at Lausnitz few more young horses

<table>
<tr><th>Age group</th><th>Teufels-brücke</th><th>Saaleck</th><th>Lausnitz</th><th>Bad Frankenhausen</th><th>Lenge-feld</th></tr>
<tr><td>Young (< 4 years)</td><td>14</td><td>7</td><td>6</td><td rowspan="2">4</td><td>-</td></tr>
<tr><td>Prime adult (4-8/9 years)</td><td>23</td><td>8</td><td>4</td><td>2</td></tr>
<tr><td>Old (> 8/9 years)</td><td>9</td><td>4</td><td>4</td><td>6</td><td>1</td></tr>
<tr><td>Total (N)</td><td>46</td><td>19</td><td>14</td><td>10</td><td>3</td></tr>
</table>

Tab. 12. Age and numbers of horse individuals according to tooth measurements in Magdalenian sites of Central Germany. References see text. Presentation in only three age classes is due to differences in documentation by the various authors cited above (see text).
Tab. 12. *Alter und Anzahl von Pferdeindividuen aufgrund der Morphometrie von Zähnen in Magdalénien-Fundstellen in Mitteldeutschland. Verweise siehe Text. Die Darstellung in nur drei Altersklassen ist auf die Unterschiede in der Dokumentation der verschiedenen oben zitierten Autoren (siehe Text) zurückzuführen.*

occur. For Oelknitz, the dominance of prime-adult horses is interpreted as being the result of successive hunting events where hunters lay in ambush to target individuals of specific age and sex (Gaudzinski-Windheuser 2013: 64). At Monruz and Champréveyres, where horse individuals could be attributed to single hearth-use phases, also only single or few horses were killed during a hunt (Morel & Müller 1997: 127-128; Müller 2013: 50, 114 & 181-182). But, when following the argumentation for Monruz, the pre-dominance of prime-adult horses is no indication of a conscious selection of that age class but should rather reflect a random killing of individuals of a family group. Prime adults and very young animals of up to 2 years of age are the most numerous in that group, with the very young animals preserving less well. (Müller 2013: 176-182).

At the Upper Magdalenian sites in Central Germany all skeletal elements of horse are present (Berke 1989: 193; Küßner 2009: 34, 45; Brasser 2010/11: 32; Uthmeier et al. 2017: 317; but see Mania 1999: 162; Gaudzinski-Windheuser 2013: 129 & 189). Of course, a superposition of different transport events cannot be ruled out (Marín et al. 2017). When following Morel & Müller (1997: 29) and Müller (2013: 34 & 189), presence of all skeletal elements indicates that after a successful hunt the entire horse, whether complete or divided (Lyman 1994: 299), was brought to Teufelsbrücke and consumed here completely (Lyman 1994: 224-234) without export of animal parts for caching and/or future consumption. Import of complete horses indicates that enough carriers were available and/or that the kill site was in the immediate vicinity (Schoville & Otárola-Castillo 2014). To illustrate this indication, a singular observation of the Hadza, recent foragers in Tanzania, shows that seven males carried an entire equid, a zebra, to their camp located 1,6 km away (Bunn et al. 1988: 444). This observation should just give an impression on distance and numbers of active persons in a recent hunter-gatherer community – it is no analogy as, in contrast to the Upper Magdalenian (Fig. 20), the Hadza are described "central-place foragers" (Marlowe 2010: 103). Today, it may be impossible to locate precisely Pleistocene hunting areas or kill sites, in particular as the recent, more smooth landscape morphology does not represent the high relief of the Late Weichselian steppe/tundra (Pasda & Weiß 2020: 71). Maybe, like at Monruz where horses were possibly driven towards hunters lying in ambush at a strategically favourable place (Müller 2013: 180-182), one can speculate that the topographic location of Teufelsbrücke at the end of a spur (see Fig. 1) was such a strategically favourable place. Once the hunt was successful, like at Monruz (Müller et al. 2006), the camp was installed directly at the kill site or close by. The existence of the small cave/rock shelter Teufelsbrücke nearby made this locality the more attractive when consumption of the prey had to be done under wet and/or windy conditions. Last but not least, it is important to emphasize that the Teufelsbrücke assemblage represents only one part of the Late Weichselian landscape with many more comparable but undiscovered sites in the open air on the spur, the part which survived erosion in a sediment trap of the cave/rock shelter.

Conclusion

The re-investigation of the faunal assemblage from the 1970-72 excavation at Teufelsbrücke (Thuringia) shows that the main artefact and bone material represents remains from Upper Magdalenian humans between c. 16-15 ka calBP. A cold-climate, steppe/tundra environment is indicated by presence of horse, reindeer, ibex, arctic hare, arctic fox, mammoth, woolly rhinoceros, lynx, wolverine, ptarmigan and marmot. As in other Upper Magdalenian sites in Central Germany, horse is the most dominant species which was hunted in summer and autumn. At the very least 60 horses were consumed at the site, but the extended MNI points rather to a number close to 200 horses. The whole prey was brought into the cave/rock shelter, indicating enough carriers and/or proximity to the kill site. Humans left a high amount of lithic and organic artefacts, among them engravings, as well as worked teeth and bones. Speculating about the number of human stays, the whole material record may be the result of some 60 visits at the least, and possibly up to 200 reoccupations of the site after successful hunting episodes of small human groups.

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